Proceedings of the Second Endangered Species and Prairie Conservation Workshop

Geoffrey L. Holroyd
Gordon Burns
Hugh C. Smith

Provincial Museum of Alberta

Natural History

Occasional Paper No. 15

1991

PROCEEDINGS OF THE SECOND ENDANGERED SPECIES AND PRAIRIE CONSERVATION WORKSHOP

JANUARY 1989
AT THE SASKATCHEWAN MUSEUM
OF NATURAL HISTORY
REGINA, SASKATCHEWAN

Presented by:

The Saskatchewan Natural History Society

Edited by:

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Prepared and Published by:

Natural History Section
Provincial Museum of Alberta
12845 - 102 Avenue
Edmonton, Alberta
T5N 0M6

91-03998/

NATURAL HISTORY OCCASIONAL PAPER SERIES

Occasional Paper titles are Published by the Provincial Museum of Alberta on subjects pertaining to the natural history of Alberta. Potential contributors are requested to submit manuscript proposals to the Assistant Director, Curatorial, Provincial Museum of Alberta, 12845-102 Avenue, Edmonton, Alberta T5N 0M6.

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CATALOGUING IN PUBLICATION DATA

Endangered Species and Prairie Conservation Workshop (2nd : 1989 : Regina, Sask.)

Proceedings of the second Endangered Species and Prairie Conservation Workshop, January 1989 at the Saskatchewan Museum of Natural History, Regina, Saskatchewan

(Provincial Museum of Alberta natural history occasional paper,
ISSN 0838-5971 ; no. 15)
Includes bibliographical references.

ISBN 0-7732-0541-1

1. Endangered species - Prairie Provinces - Congresses. 2. Nature conservation - Prairie Provinces - Congresses. I. Holroyd, Geoffrey L. II. Burns, Gordon R. (Gordon Russell), 1954- III. Smith, Hugh C. IV. Saskatchewan Museum of Natural History. V. Saskatchewan Natural History Society. VI. Provincial Museum of Alberta. Natural History Section. VII. Series: Natural history occasional paper ; no. 15 VIII. Title.

QH77.C2E52 1989 574.5'29'09712

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ACKNOWLEDGMENTS

The success of this conference has been made possible by the generous contributions of energy, time, and money from the following individuals, institutions, and agencies.

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PUBLICATION

This Occasional Paper was prepared by the Natural History Section of the Provincial Museum of Alberta. The efforts of Ross I. Hastings, Mark Steinhilber, and W. Bruce McGillivray in creating the final layout and producing the published document are gratefully acknowledged.

1. OPENING PLENARY SESSIONS

OPENING WELCOME

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On behalf of the organizing committee, I welcome you to the second workshop on prairie and endangered species conservation. Your interest reflects the values that most Canadians place on wildlife conservation (Filion et al. 1983) and the desire of many people in the prairie provinces to develop linkages between agriculture and wildlife.

The first endangered species workshop was held at the Provincial Museum of Alberta in Edmonton in January 1986. The focus of that workshop was on endangered species and native habitat. The proceedings from that workshop with almost 100 papers, are available from the Edmonton Natural History Club (Box 1582, Edmonton, Alberta, T5J 2N9, $10 plus postage).

That first workshop gave rise to some new initiatives. In Alberta, the Alberta Bird Atlas and the Alberta Native Plant Council were formed. Recovery teams did not exist then. Now recovery teams have drafted recovery plans for seven species [Peregrine Falcon (*Falco peregrinus*), Whooping Crane (*Grus americana*), Piping Plover (*Charadrius melodus*), Wood Bison (*Bison bison athabascae*), Swift Fox (*Vulpes velox*), Loggerhead Shrike (*Lanius ludovicianus*), and Burrowing Owl (*Athene cunicularia*)]. In the past three years, in all three prairie provinces, World Wildlife Fund Canada conducted the Wild West Program which sponsored more than $1 million of projects on endangered species and endangered spaces. A major accomplishment of Wild West was the publication of the Prairie Conservation Action Plan in 1988. The action plan which has been endorsed by the premiers of Manitoba and Saskatchewan and the wildlife minister in Alberta, is one focus of this workshop. In Alberta,the action plan has led to a new joint venture between Alberta Forestry, Lands and Wildlife and WWF titled Prairie for Tommorrow with a focus on land owners. In Saskatchewan,the Endangered Species Recovery Fund will encourage more conservation of endangered species and in Manitoba,the Action Plan is being incorporated into a more comprehensive Conservation Strategy.

The theme of this workshop is "Agriculture and Wildlife, Partners in Prairie Conservation." The prairies of Canada support a major agricultural economy and a declining abundance of wildlife. Soil erosion and water quality threaten the long term viability of agriculture. One half of Canada's endangered and threatened birds and mammals share the prairies. Waterfowl populations have declined 60%. Wise soil, water, and land management are needed to solve these dependent situations. This workshop will address the issues of how to manage the prairies to promote sustainable agriculture and to conserve the wildlife that are in jeopardy.

The objectives of the workshop are:

1. To find economic and environmental linkages between the agriculture and wildlife agencies that can be used to promote wise management of the prairies as suggested in the World Conservation Strategy.

2. To determine how to implement the Prairie Conservation Action Plan, which is the broad strategy to manage the natural portions of the prairie environment.

3. To encourage the recovery efforts on wildlife in jeopardy by determining the information needs for each species and possible management actions that could be undertaken.

An underlying assumption of the workshop is that we are all here on the prairies for a long time not just a good time!

The workshop is structured into plenary sessions, auditorium lectures, and working sessions. The plenary sessions will provide all of us with current information about major issues and activities affecting the prairies and some philosophical perspectives for our discussions. In the auditorium lectures, you can learn about species and conservation activities that are ongoing on the prairies. The working sessions are the core of the workshops. Their objective is to generate lists of specific action items that can be undertaken to advance the issues under discussion. The sessions will begin with brief technical presentations about the issues and then continue with a discussion of actions that are needed to resolve any problems.

In the sessions that are oriented towards species, the challenge is to determine how to include biological concerns into the socio-economic issues that affect agriculture. In the sessions that discuss the goals of the Prairie Conservation Action Plan, the purpose is to recommend what actions are needed to accomplish the goals and who should act. In the agriculture sessions, we need to define the concerns and discuss actions to promote mutually beneficial solutions. Working sessions will use the strategy of effective negotiations by first agreeing on a problem statement or objective. Then, through discussion, identify assumptions about the topic at hand. Then list all possible suggested actions and solutions to gather as many ideas as possible. Throughout the working sessions you should maintain a positive approach. Such "brainstorming" sessions should not focus on what is wrong with an idea or its practicality. Focus on what is right and improve on previous ideas.

This is obviously an ambitious agenda but it is attainable because in western Canada we have many dedicated and talented people committed to the conservation of Canada's agriculture and wildlife. Together we can make it happen!

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STRATEGIC THINKING AND THE PRAIRIE CONSERVATION ACTION PLAN

Mike Kelly

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INTRODUCTION

The World Conservation Strategy Conference held in Ottawa a couple of years ago, like this workshop, was a progress reporting and planning session. There are many parallels between that conference and this one. Both conferences are dedicated to the principles of the World Conservation Strategy (WCS). Both are forward looking and anticipate considerable progress over the next few years. Both are, to some extent, a celebration of work done and both conferences take place in an atmosphere of enthusiasm, maybe even optimism, in spite of the serious nature of the problems we are here to address.

We all recognize the truth of the ecological principle that "everything is connected to everything else in the natural world." The same truism applies to the world of human ideas.

What brings us together and will link us long after we leave is a great chain of ideas. These ideas began long before the WCS and some of the most important ideas ever conceived by humans. The core idea has been stated in many ways but the words of Aldo Leopold quoted in the Prairie Conservation Action Plan are as good as any. He said, "When we see land as a community to which we belong, we may begin to use it with love and respect."

What the World Conservation Strategy did was put a lot of very important and generally well-known ideas into one package. The WCS organized these ideas into a cohesive pattern and coherent program for action.

Whenever the topic of strategies and strategic planning comes up, I am reminded of what one of the great thinkers of our time said about why we should think strategically. That great thinker is the famous baseball catcher, Yogi Berra. He said, "If you don't know where you're going, you're liable to end up some place else." A good variant on that quote is, "If we don't change our direction, we're liable to end up where we're headed." In the case of the native prairie species and ecosystems, we are headed for extinction; we have to change our direction.

It has been said that humans more often need reminding than instructing. Whether we need it or not, I think most of us tend to resent instructing a lot more than reminding. That is the attractive message of the World Conservation Strategy and sustainable development. The WCS outlines a nice framework to help us keep the important things in mind when we go about our daily lives.

Integrating conservation and development, however, is about the toughest job there is. It affects every aspect of every life on the planet every day. It affects the lives of other living beings to a far greater extent than our own species. For many living creatures, it does not just affect their lives, but their entire species.

I have a poster on the wall in my office. It is a beautiful painting of a Jaguar on the limb of a tropical tree somewhere in Belize. The caption reads simply: Extinction is forever. That poster serves as a daily reminder of the terrible power of people. You and I can make that cat and all like it disappear from our planet forever...without even trying. That is the key idea here and the idea that we have to bring home to everyone on the planet. Without even trying, we can and will bring tragic destruction to zillions of wonderful things on this little planet unless we start moving in a slightly different direction. We are headed towards that "some place else" that Yogi and I worry about. We have to adjust our course a bit or we'll end up where we're headed.

What might be that new direction and how do we adjust the course of the supertanker we call economic development? One thing is fairly clear: it is going to be the 1000 little changes that ultimately makes a difference. Waiting around for that single 100 percent change is a fool's game. A conscious, deliberate shift towards environmentally sustainable development would help. Protection and preservation of our biological base seems fairly important. Those attending this workshop are starting to follow new paths consistent with sustainable development.

We should celebrate the tremendous strides that are represented by the Prairie Conservation Action Plan. It took the instigation and funding of World Wildlife Fund Canada and cooperation of three provincial governments, several agencies of the federal government, numerous non-government organizations, and hundreds of people like you to accomplish this. A small band of people managed to pull together a few resources, organized their work, and multiplied their impact manyfold.

WHAT EVENTS LED UP TO THE PRAIRIE CONSERVATION ACTION PLAN?

Environmentalism goes back as far as human history. Over the holidays, I returned to the American southwest to hike and marvel over the natural wonders including that of the ancient Indians, called the Anasazi, and the ruins they left behind. Current evidence indicates that these incredible civilizations crumbled and disappeared due to a combination of over exploitation of resources and climate change. Sound at all familiar? In Chaco Canyon, there are the remains of amazingly complex irrigation systems to bring rain water from the mesas to the parched soil in the valleys. These represent the final hours of their civilization.

Closer to home, Canada has a long history of conservation and sustainable development. For example, the Commission of Conservation was established by the Parliament of Canada in 1909. This commission is credited with giving impetus to many new activities in Canada: expansion of our system of national parks, improved agricultural practices, improved resource management education, improved sewage treatment, a federal health department, and the beginnings of town planning in Canada, just to name a few.

To illustrate how this commission anticipated the concept of sustainable development without the catchy phrase, I want to quote briefly from the first Chair of the Commission of Conservation in Canada, Sir Clifford Sifton, speaking in 1908. He said, "...I have heard the view expressed that what Canada wants is development and exploitation, not conservation. This view, however, is founded upon an erroneous concept which must be our work to remove. If we attempt to stand in the way of development, our efforts will assuredly be of no avail either to stop development or to promote conservation. It will not however, be hard to show that the best and most highly economic development and exploitation in the interest of the people can only take place by having regard to the principles of conservation."

It has not really been said better since. Conservation strategies or environmentally sustainable development is based on simple common sense. With the advent of the World Conservation Strategy, the common sense principles and ideas were organized and the power of science was applied to help put these ideas into action. The World Conservation Strategy was developed between 1975 and 1980. Following its publication, the WCS came to be seen as the seminal document on systematically approaching the problems of environment and development. Up until 1986, 40 to 50 nations either had completed or were developing national conservation strategies. Since that time, the number has increased, but much more importantly, more localized strategies have been popping up. It seemed that the strong scientific base of the World Conservation Strategy was more popular and applicable at a smaller scale than that of a nation.

The World Conservation Strategy has always had the support of scientists and planners and others who prefer a thoughtful, rational, and systematic approach to problem solving. The WCS appealed to lots of people who were not in positions of power. Progress, slow progress, was made. Then along came the Brundtland Commission, also known as the World Commission on Environment and Development. This group of 22 prestigious people was commissioned by the United Nations to investigate and report on the state of world's environment and to formulate a global agenda for change.

Their report, called Our Common Future, was released in April 1987. Unlike the roughly 70 page World Conservation Strategy, their 383 page report was published as a paperback book. The Brundtland Report is being hailed as the most significant work on the environment in human history.

At first I was puzzled by its spectacular acceptance throughout the world. I could not find a coherent, rational, scientifically-based plan of attack. The World Conservation Strategy and Our Common Future take us in exactly the same direction but the widespread appeal of the Brundtland Commission far surpasses that of the WCS. Why? The World Conservation Strategy was developed and written by scientists whereas many of the Brundtland Commissioners are top ranking politicians. They knew how to get things done in the arena of international politics and economics. Their report is a factual, emotional, and even charismatic statement about the world today. In spite of its popular appeal, the Brundtland Report provides substantial and excellent advice on how to begin resolving many of the issues and problems discussed in the report. Our Common Future places great stock in conservation strategies. The report says, "The world must quickly design strategies that will allow nations to move from their present, often destructive, processes of growth and development onto sustainable development paths."

The Brundtland Commission has politically and economically legitimized what scientists, environmentalists, planners, and ordinary people had been saying for many years. The Brundtland Commission has helped tremendously to empower groups such as this one to carry on with our projects and to do so with the support of the economic systems of the world. Our Common Future has captured the imagination and mobilized people like nothing I have seen before.

We have a long way to go, however, and it is going to take endless patience and attention to detail to make progress. The concept of environmentally sustainable development will not be simple to implement, measure, test, and experiment with the real world. Implementation will be successful because the issues of the environment and its connections to our economy are finally on the agenda of the public. We have reached a new plateau in our understanding about what must be done to secure the future we all share. I am confident we shall see more and more practical and feasible examples of sustainable development in action.

You are among the leaders putting forward one of these practical examples. The progress of this project is going to be monitored and studied by many people. During the course of my work on the Alberta Conservation Strategy Project, we received letters from every corner of the globe concerning our work. We correspond with people in over 40 nations. This project may attract even more attention because you are moving right past the talk and into practical applications.

The World Conservation Strategy presented three objectives or conditions that are necessary for a sustainable world. The Prairie Conservation Action Plan focuses on maintaining biological diversity, the second of these objectives. The other two objectives, maintaining essential ecological processes and life support systems and the sustainable use of resources, are an integral part of the Plan as well.

In many countries, the loss of biological diversity and the failure to protect natural areas and habitat is literally the primary issue for the survival of their people. What the Prairie Conservation Action Plan can offer by way of example and experience should not be underestimated. Virtually all the same steps and processes necessary for the success of this project will be needed in other parts of the world. The lessons that can be learned from this project may save considerable time and resources in places that have neither to waste on simple mistakes. People associated with this project might someday help implement similar programs in other parts of Canada and the world.

Invisible and intangible benefits of sustainable development are often the most significant in the long run. What we do at this workshop is part of that great chain of ideas mentioned earlier. I think the Prairie Conservation Action Plan will not only help to extend that chain of ideas, but also bring about some welcome and beneficial changes in the direction we are headed.

I owe a debt of gratitude to Dr. Trevor Hancock in Toronto, a Public Health Consultant (of all things) for my closing words. (The fact that a public health consultant is actively involved in sustainable development as a vehicle for community health tells a story in itself. It never ceases to amaze me the breadth of appeal represented by the concept of sustainable development and taking a strategic perspective on the environment and economy.)

Trevor's quote is from Professor Frank Adams, a member of the Commission of Conservation mentioned earlier. He said these words in his presidential address before the Royal Society of Canada in 1914, "In conclusion it may be said that we have seen that Canada has been blessed with great natural resources. Each and all of these, however, already show signs of serious depletion. Each and all of these resources of our national domain (with the exception of the mineral deposits) can, however, not only be made to yield a higher annual return than at present, but while doing so to increase in value year by year, and be handed on by each generation to the succeeding one in a better and more productive condition than that in which it received them. It is time for people of Canada to awake to the realization of these facts, and in so doing to remember that in the last analysis the success of any policy of conservation depends upon the efficiency of the human unit. The instinct of the savage which still survives in the ordinary man, inclines him to seize what he can now and for himself, and let others, including posterity, take their chances. The national instinct for the preservation of the State does not, however, lend itself to any such practice of personal aggrandizement and selfish waste."

Here's the message I want to leave you with. We are following a long and hallowed tradition in Canada and one that is now breaking on the world scene with great power. We can take some comfort from this fact and from the fact that great things came from the Commission on Conservation. With the prairie Conservation Action Plan in place and the efforts of each of you at this workshop and for the next few years, many great new things will come from your work too.

THE PRAIRIE HABITAT JOINT VENTURE AND LINKS WITH THE PRAIRIE CONSERVATION ACTION PLAN (OR PLOWS, PINTAILS, AND PIPING PLOVERS)

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The North American Waterfowl Management Plan (NAWMP) was signed by Canada and the United States in 1986. The objective of the Plan is to restore continental waterfowl populations to the levels of the 1970s. This will be accomplished through a combination of habitat enhancement and improved harvest regulation. New initiatives identified in the Plan will cost about $1 billion to implement over the next 15 years.

By far the largest component of the Plan is a habitat restoration program for Prairie Canada which focuses on the prairie/parkland region. Because of the magnitude of the program required, the NAWMP calls for the formation of a Joint Venture between private and public agencies in Canada and the U.S. to plan, fund, and implement this massive habitat restoration effort. American sources are expected to pay 75% of the almost $1 billion price tag with Canadian sources paying the other 25%. Planning of this Joint Venture has been under way for almost 2 years now and will culminate with the announcement of the forming of the Prairie Habitat Joint Venture Advisory Board. This will initially be made up of representatives of the Government of Canada (Environment and possibly Agriculture), Government of Alberta, Government of Saskatchewan, Government of Manitoba, Delta Waterfowl and Wetlands Research Station, Ducks Unlimited Canada, and Wildlife Habitat Canada. These organizations have guided the development of the Joint Venture concept and have overseen the program planning within each of the provinces.

The underlying premise in developing the program plans is that habitat loss and degradation, both in terms of wetland and upland habitat, have so severely limited the reproductive capability of waterfowl that most populations are unable to sustain themselves. The primary factor responsible for this is the progressive intensification of agricultural use of the land. Emphasis on the production of a relatively small number of annual crops combined with the elimination of native vegetation to make way for an expanding agricultural land base has had two effects. It has directly eliminated much of the habitat in which prairie waterfowl and other wildlife evolved, replacing it with a vegetative cover which is more seasonal at best and non-existent at worst in the case of summerfallowed land. In addition, agricultural activity has greatly reduced the complexity and diversity of the prairie landscape, making it a more unstable environment and one in which there are fewer forms of life capable of sustained existence.

Agricultural intensification is now reaching the point, however, where the environmental modifications have been so extreme as to begin to impair the functioning of the system and bring into serious question the sustainability of the agricultural industry. This concern has been heightened in the last few years by the declining market for our high quality commodities, particularly cereals, and recent information suggesting that prairie Canada will undergo a fairly substantial climate change in the next few decades.

With current land management practices and land use policies as the common root cause of both habitat loss and reduced sustainability of agriculture, new windows of opportunity are opened for developing an integrated approach to land use in western Canada. Planning of the Prairie Habitat Joint Venture has incorporated this new avenue of habitat retention.

The habitat programs of the Joint Venture will fall into one of three categories. The first, perhaps the simplest, is the preservation and management of the remaining unprotected large marshes in the prairie and parkland biomes which serve as important breeding, staging, or molting areas for waterfowl. Many of these require nothing more than being given protection through special designation by the provincial government involved. Others may require, in addition to protection, the provision of some management to restore them to diverse, productive wetland systems. As a part of the initial planning effort, preliminary lists of such wetlands have been developed in each province. Once the selections have been finalized and needs identified, all should have management plans developed which will guide subsequent management activities.

A second array of programs will focus on the need to protect the small wetland complexes and associated uplands which occur largely on private lands. These habitats are subject to continuing pressure from agricultural development, either for wetland drainage or progressively more intense cultivation of the uplands. The strategy is to work out financial arrangements with landowners to encourage them to refrain from draining these wetlands and restore adjacent uplands currently in an annual cropping regime to some sort of perennial vegetative cover. Once established, this cover would be either for exclusive use as wildlife habitat or for less intensive agricultural use compatible with its main purpose as wildlife habitat. The techniques envisaged will range from the establishment of small intensively managed blocks of dense nesting cover in areas of high pothole density to the encouragement of landowners through financial incentives to adopt conservation farming practices which would leave a more substantial trash and litter cover on the soil surface. Practices such as reduced tillage, rotational grazing, green manuring, and modified haying practices would have the two-fold benefit of providing improved habitat for a variety of wildlife and improved soil management. It is expected that this second component of the program will consume the largest portion of the cost of the Joint Venture. To the greatest extent possible, it will be integrated with current and developing soil conservation programs of agriculture in those regions where there is an overlap between waterfowl and soil conservation interests.

The third component of the program is built on the strategy of promoting subtle changes in land use over a broad area of prairie Canada. This approach is longer term and involves developing a much closer integration of agricultural programs and policies with those of other resource interests including wildlife. The ultimate objective would be to manage the landscape for optimum diversity, stability, and sustainability. Key thrusts would include developing wildlife habitat components in programs of other land and water management agencies, planning and implementing integrated soil and water conservation initiatives with other agencies, modifying government incentives and policies that directly or indirectly contribute to habitat destruction and establishing multiple use management practices that maintain or enhance wildlife habitat on public lands.

In summary, then, I have described the three approaches to habitat restoration of the Joint Venture: preservation of remaining large wetlands, an incentive program to alter land use in pothole areas, and a long term program to effect subtle land-use changes over broad areas of prairie Canada. There are two other aspects of the Joint Venture I would like to discuss.

First, as an integral part of the Joint Venture, waterfowl crop damage control programs will be enhanced to ensure that grain farmers are adequately protected from financial loss due to "web-footed combines." Second, Joint Venture programs will be evaluated to determine their effectiveness in meeting the objectives of the North American Waterfowl Management Plan.

Work is already under way in each province with a number of pilot projects having been started since the North American Waterfowl Management Plan was signed. The first two internationally cost-shared projects began recently in Alberta (Buffalo Lake Moraine) and Saskatchewan (Quill Lake/Touchwood Hills).

This program, duck-driven though it may be, is linked to the objectives of the Prairie Conservation Action Plan and has an impact on habitat of non-target species of wildlife. There are at least three objectives in the Prairie Conservation Action Plan which overlap very closely with the Joint Venture.

Goal 8. "Encourage balanced use of private lands that allows sustained use of the land while maintaining and enhancing the native biological diversity of the prairies."

Many of the large wetlands targeted by the Joint Venture have substantial tracts of native grassland adjacent to them. As at Oak Hammock Marsh near Winnipeg, these could be identified as a priority for purchase and incorporated as an integral part of the management plan. Similarly, there still are considerable amounts of native prairie associated with wetland complexes such as in the Missouri Coteau. Such tracts would be of high priority for preservation, as far as the Joint Venture is concerned, because there would be no costs associated with establishing a vegetative cover as there would be on cultivated land. The long term program of the Joint Venture is completely supportive of this goal because it also seeks policy changes and incentives which would encourage the maintenance of native cover on marginal farmlands.

Goal 9. "Promote public awareness of the values and importance of prairie wildlife and wild places."

The Joint Venture will mount a communication/public information program currently estimated to cost $10 million over 15 years. The major themes will be the importance of prairie habitat to waterfowl and other wildlife, the importance of protecting fragile lands, and the need for greater soil and water conservation initiatives by all resource users.

Goal 10. "Promote research relevant to prairie conservation."

Presently, a Joint Venture Evaluation Group is designing a research and evaluation program that will measure the impact of the habitat programs on target species. Where appropriate, non-target species could be included with little or perhaps no extra costs. This could give valuable insight into the distribution of both plants and animals of interest in a broad prairie context.

Additionally, the Joint Venture will have a demand for perennial grasses and forbs with low post-establishment maintenance costs. Such a market would be an important justification for the establishment of research facilities interested in the propagation and management of native prairie species. Conceivably, the Joint Venture could be a financial partner in such an undertaking.

To summarize, I see three major links between the Joint Venture and the Prairie Conservation Action Plan. The degree to which they become mutually supportive to the greater good of both initiatives will be a measure of our ingenuity.

I would like to speculate about the potential impact of the Joint Venture's program on non-target species of prairie wildlife. To the extent that its programs are successful in promoting increased diversity of landscape, I believe the Joint Venture will be of benefit or neutral for most species. Clearly, prairie wildlife abundance and diversity has been reduced as a result of man imposing a much simpler system of primary producers on the prairie ecosystem. Therefore, any reversal of this trend will be beneficial.

There are a few examples I can cite of opportunities within the Joint Venture where some very positive strides could be made. About 10 years ago, while I was Chief Biologist for Ducks Unlimited Canada, Guy Morrison of the Canadian Wildlife Service and I speculated on the possibility of establishing a series of D.U. projects as migratory stepping stones for shorebirds and managing water levels in spring and fall to provide optimum habitat for these birds to stage and "refuel." If we knew the set of physical conditions required to create that habitat naturally, then we could find projects with the proper bottom contours, appropriate water chemistry, adequate water supply and, with the capability to manipulate water levels, we would be able to create mud flat conditions on a reliable basis every year. Given enough of these basins, we could create a series of shorebird hostels across the prairies with very little cost other than that for annual water management. Many of the large wetlands which are secured by the Joint Venture could be managed for shorebird staging as well as waterfowl. All that would be required would be shorebird expertise and relatively few dollars to be added to the planning and management phases of this program.

Another area of potential benefit is the series of programs designed to return fragile cultivated lands to a perennial cover crop in pothole areas. If methods could be devised to plant seed of native prairie species so that at least the dominants were representative of the native prairie assemblage, we would have a considerably greater impact on increasing species diversity than if the Joint Venture had to rely on tame or introduced varieties. All that is required to make this possible is for a willing partner with the expertise and a few dollars to come forward and join the Joint Venture.

There is, however, the potential for negative spinoffs as well. Like the promotion of agricultural practices that depend on chemicals, we have to be certain that we are not helping to create a greater problem than we are trying to solve. Similarly, if the Joint Venture is used as a vehicle to protect tracts of native grassland, we have to be certain that these lands are managed in a way that will result in perpetuation of that community.

In conclusion, I can say with confidence that this Joint Venture offers tremendous opportunities for those interested in the preservation of prairie wildlife by virtue of its magnitude and its integrated approach to using our prairie landscape. The addition of other partners with different expertise but similar goals and a few extra resources to bring to bear could go a long way to fulfilling the aims of the Prairie Conservation Action Plan.

THE PRAIRIE CONSERVATION ACTION PLAN AS SEXUAL FOREPLAY

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INTRODUCTION

This paper deals with the Prairie Conservation Action Plan (PCAP) and is divided into three sections: (1) a very brief review of how and why the PCAP was prepared, (2) what has happened so far with respect to its implementation, and (3) what needs to happen in the future.

BRIEF REVIEW

The Prairie Conservation Action Plan is one of 90 projects mounted by a larger program called "Wild West" which World Wildlife Fund (WWF) supported in Prairie Canada from 1986 to 1988. Wild West has been directed by a steering committee of westerners representing federal and provincial governments, farmers and landowners, universities and conservation groups. The individuals representing these various groups and agencies are listed in the Plan.

The purpose of the PCAP was to present a fairly specific blueprint for what needs to be done to conserve the biological diversity of Prairie Canada and to do it in such a way that it had a good chance of being implemented.

Preparation of the Plan itself was a two step process. First, we circulated a "prospectus" or preliminary outline to 5,000 groups and individuals in the west, including agricultural agencies, for their comment. Next, based on this input, we prepared a draft and again circulated that for comment before the final document was written. As a result of this process, the PCAP has been reviewed and shaped by the key players who have to implement it.

The PCAP lays out 10 goals and specific action steps that need to be taken, by whom and by when. The critical path for the plan is 5 years (1989 - 1994) so it is timely that we are discussing it now.

The PCAP is not meant to represent the be-all and end-all and no one is suggesting it will solve all conservation problems in western Canada. But it is at least a preliminary stab and I think it is safe to say that if it were implemented, it would get us off to a running start.

WHAT HAS HAPPENED SO FAR?

First, I should emphasize that we have produced the document (5,000 copies to be exact), WWF paid for it and it has been widely circulated, especially in western Canada.

Second, press conferences have been held with Premiers and Ministers to ensure endorsement of the Plan:

(1) In Manitoba, Premier Filman and I launched the Plan on November 29. He committed Manitoba to an extensive land and water conservation program and a prairie conservation strategy, especially to protect tallgrass sites. (2) In Saskatchewan on December 5, Premier Devine and I announced a $300,000 Endangered Species Fund, costs shared with World Wildlife Fund, and he committed to reviewing agricultural subsidies that mitigate against conservation. Earlier in the year, the agreement on Grasslands National Park was announced. (3) In Alberta on December 6, the Honourable LeRoy Fjordbotten endorsed the plan on behalf of his government and he and I announced a $700,000 three year "Prairie For Tomorrow" program, with costs shared by World Wildlife Fund. This program is drafting management plans for all Alberta's threatened species, protecting key sites or habitats, and producing materials for landowners on specific things that they can do. Mike Quinn is the executive coordinator of this program.

This is a very whirlwind summary but the important point is that all three prairie province governments have endorsed the PCAP and indicated that it will serve as a guiding document for their conservation programs in the future.

Furthermore, it is extremely significant that in two provinces this support has come from the level of the Premier, sending a clear message to other Ministers, the bureaucracy, and provincial residents that they mean business. Please do not overlook that. Also, remember that it is the provinces which will have the mainline management responsibility for much of what we have recommended.

We shall likely have a press event with the federal government early this year to indicate their support of the plan and what commitments they are prepared to make.

Uncharacteristically and perhaps against my better judgement, my own organization has also made a number of follow-up commitments:

- We have committed $1 million over 4 years to the National Endangered Species Recovery Fund in partnership with Environment Canada which will be very active in the west and active in implementing the PCAP goals regarding endangered species.

- We have committed $390,000 over 3 years to the "Prairie For Tomorrow" program already mentioned in Alberta.

- We have committed $150,000 over 5 years to an Endangered Species Fund in Saskatchewan.

- We have committed $100,000 over 5 years to a Critical Wildlife Habitat program in Manitoba, especially to help with protection of tallgrass prairie.

- We currently have offices in Edmonton and Calgary.

- We shall reconvene the entire Wild West steering committee early in 1990 to assess progress on the Prairie Conservation Action Plan to that time.

- We have established and provided modest funding for Wild West follow-up committees in each of the prairie provinces.

- We continue to support nearly 100 hands-on field projects in western Canada, related directly to the goals and recommendations of the PCAP.

I mention all this not to boast but because it is very unusual for WWF to stick around like this after a regional program such as Wild West. In fact, we indicated very clearly from the first that we wanted to serve as a catalyst, not a crutch. I therefore feel our organization has already gone the extra mile, if not too far, both financially and in terms of stretching our own staff resources for Prairie Canada. In other words, the ball is now very much in your court. I am not going to be very receptive to recommendations from this conference that WWF undertake further commitments. And that brings me to my third and final topic.

WHAT NEEDS TO HAPPEN IN THE FUTURE?

Three things. First, I believe the conservation community in western Canada, both government and non-government, are being handed a golden opportunity. You have a conservation plan which enjoys broad-based involvement in terms of its preparation and formal government support from the highest level. If you agree with it, the onus is on you to make sure that it is implemented. We need to ride herd and pitch in. If nothing happens, in large part we shall have ourselves to blame.

Second, it is still early in the game, so this conference presents a perfect opportunity to evaluate commitments made to date, to figure out what more needs to be done, and to establish mechanisms for monitoring progress. Conference organizers hoped that the meeting would serve this specific function.

Third, the PCAP needs to be seen as part of a larger national initiative to complete a network of protected areas in Canada.

Specifically, our goal should be to adequately represent every natural region of Canada as determined by federal, provincial, and territorial jurisdictions by the year 2000. The total area protected should represent at least 12% of Canada's lands and waters - a number recommended in "Our Common Future," the report of the World Commission on Environment and Development chaired by Gro Brundtland. This agenda for Canada will be outlined in detail in a WWF book entitled "Endangered Spaces" to be released this fall.

To accomplish this national agenda, I think we must convince those who are mouthing the platitudes of sustainable development these days that it means more than managing every square centimetre of the planet. Sustainable development also means setting aside a network of protected areas important in their own right and useful as natural benchmarks against which to measure change and as reservoirs for genetic resources which we shall desperately need in the future.

SUMMARY

Please read the PCAP and decide whether or not it is worth supporting in part or in whole. It is not everything but it is a good start, especially as an agenda for the next 5 years.

A great deal has already been done to promote and win over support for the plan. Please take advantage of this so as not to lose a hard-won opportunity.

Let us organize to make sure the plan gets implemented, let us use this conference as part of that process and let us ensure that our efforts contribute to a larger national game plan.

One final remark: I certainly appreciated an earlier speaker's high praise for those of us involved in preparing the Prairie Conservation Action Plan, however, he referred to it as a "remarkable accomplishment" and as a "significant action."

Let me confess something to you all. I hate plans and I hate them precisely because people tend to confuse them with action. We are never going to save this planet based on what we are always planning to do.

A plan is not an action. A plan means absolutely nothing if it is not followed through. So think of the PCAP as sexual foreplay; it only sets the stage for the real thing. I leave it with you.

AN EVALUATION OF THE VULNERABILITY OF CANADIAN MIGRATORY BIRDS TO CHANGES IN NEOTROPICAL FOREST HABITATS

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The following text is the executive summary from Diamond (1986).

(1) Tropical forest is being destroyed so rapidly that there is widespread scientific concern about the global consequences. These include the loss of a high proportion, perhaps half, of the world's genetic diversity (sources of crops, medicines, timber, and industrial raw materials), the extinction of a similar proportion of the planet's species of flora and fauna, global climatic change, and political, social, and economic instability resulting from environmental damage in tropical countries.

(2) Canada as a whole is as susceptible to these consequences and is as responsible for their causes as any other developed nation. Of direct and particular concern to Conservation and Protection, and especially the Canadian Wildlife Service, is the imminent loss of winter habitat for 90 species of birds that breed in Canada and migrate to Latin American forests for the winter. About half of these species either winter widely in the U.S. as well as in the tropics or are mainly American species extending into Canada only in extreme southern Ontario; the remaining 44 species breed widely in Canada and winter almost entirely in tropical forest.

(3) Some of the species concerned are known to be of potential economic importance as controllers of forest-insect pests. All of them are highly valued by the Canadian public as a whole. Most are songbirds whose loss would constitute a second "Silent Spring" rivalling the spectacular declines in bird-life of the 1960s that were brought about by excessive use of pesticides.

(4) Estimates of the rates of deforestation are compiled globally by the Food and Agriculture Organization of the United Nations. FAO's deforestation estimates are not entirely appropriate for measuring habitat but have been corrected as far as possible. The distribution and habitat use of North American migrant birds in the Neotropics, the tropical zone of the western hemisphere, have been compiled by World Wildlife Fund - U.S. These two data sets are matched to provide estimates of the area of winter forest habitat available to Canadian migratory birds at two times, 1985 and the year 2000. The rate and direction of change between 1985 and 2000 is used as an index of the vulnerability of each species to loss of winter habitat by tropical deforestation. Because the FAO figures under-estimate deforestation, and especially the loss of secondary forest, this measure is a *conservative* index of vulnerability; species are certainly more vulnerable than this index suggests. By this measure, more than half of the bird species which breed in Canadian forests and migrate to the tropics in winter are likely to lose more than 25% of their winter habitat by the year 2000 and twelve species are expected to lose half or more of their winter habitat.

(5) There is no routine monitoring of changes in forest habitats in the area most critical to Canadian migratory birds (Central America) partly because it lies between LANDSAT receiving stations. There is an urgent need to set up a scheme using satellite technology to monitor the loss of forest in Central and northern South America.

(6) Existing schemes to monitor long-term population trends in migratory forest birds do not show consistent declines in species that migrate to the tropics. However all are flawed in their ability to detect such changes; there is a need to review these schemes in relation to this problem.

(7) Existing information on the population density and structure of migratory bird species in neotropical habitats is inadequate and urgently needs to be improved if the effects of habitat loss on population sizes are to be evaluated.

(8) Research called for in (6) and (7) will require cooperation between professional and volunteer ornithologists, between Canadian and U.S. wildlife biologists and between Canadian and Latin American researchers and institutions. There is outstanding potential for cooperative projects focusing the ac-

tivities of the many players involved on a single issue whose resolution will benefit all concerned.

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INTRODUCTION: COPING WITH CLIMATE CHANGE ON THE PRAIRIES

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Climate change is a very obvious phenomena to those of us living in the temperate zone. We all feel the changes from winter to summer and back again but lately we are beginning to wonder if this seemingly predictable pattern itself is beginning to change. I grew up in England and came to the prairies in the mid-1960s when I was 9 years old. I can remember my first winters in Edmonton when temperatures routinely dropped to -30 ° F and the snow seemed so deep that we had to dig ourselves out from the front door and carve a tunnel through snow over my head in order to get to our car on the street. Today, we have warmer winters with very little snow while our once hot and dry summers now seem cooler with erratic swings in temperature and precipitation.

Global warming, climate change, and the greenhouse effect are front page news. We read about melting of the polar ice caps, rising sea levels, and the possible displacement of one half of the world's population. Papers of this session will bring this subject closer to home and will discuss the implications of climate change on the prairies.

CLIMATE CHANGE - IMPLICATIONS FOR THE PRAIRIES

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NOTE: The following text has been prepared by session chairperson Miles Scott-Brown based on a summary provided by the participant.

The greenhouse effect is, in part, a reason why we have a warm, green, and fertile planet earth, instead of it being a barren, cold, and infertile rock. Our atmosphere allows short-wave radiation to pass through readily to warm the earth and allow for photosynthesis. Longer wave radiation is re-radiated from the earth's surface back to space to maintain a balance between incoming and outgoing radiant energy. Some of the outgoing heat is absorbed by carbon dioxide and other gases in the atmosphere and re-radiated back down to the earth's surface. As the amount of these greenhouse gases increases in the atmosphere, a slow and steady rise in temperature is predicted to result.

Carbon dioxide is one greenhouse gas but other important gases are methane and chlorofluorcarbons or CFCs. While there has been a documented increase in global carbon dioxide from about 290 ppm at the time of the Industrial Revolution to about 340 ppm today, we are not certain if mankind is responsible for global warming. We are certain though that mankind has been responsible for the increase in CFCs. CCl_3F has increased from a level of zero in the 1800s to 0.22 ppb today and CFC-12 has increased from zero to 0.38 ppb. CFCs are not only responsible for global warming but they have also been implicated in the breakdown of ozone in the stratosphere. Methane levels have increased from 0.7 ppm in the 1800s to today's level of about 1.7 ppm.

Greenhouse gases alone are not entirely responsible for global warming. At the same time that levels of these gases in our atmosphere are increasing, we are removing a forested area of the size of Great Britain every year. These forests if left uncut could be very important in helping to reduce carbon dioxide levels.

Are we seeing global warming today? Certainly the summers of 1987 and 1988 have been very warm and we can now say with certainty that this temperature increase is at the limit of natural variability, but we have also been much warmer in the past. About 125,000 years ago, the earth's temperature was about 2° to 3° C warmer and 8000 years ago, a 1.5° C increase over today resulted in lakes in the Sahara and a movement northwards of our boreal forest by about 300 km. Between 950 and 1050 A.D., temperatures were about 1° C warmer and grapes grew in the United Kingdom.

What do our climate models predict about global warming? It appears that warming will continue to be more pronounced in winter than in the summer months. It will be drier in the wheatlands of Argentina, North America, and Siberia and, depending on the model, there could be a 50% reduction in summer soil moisture. While climate conditions may favour the growth of cereal crops in more northerly areas, the outlook for the drought stricken areas of southeastern Alberta and southwestern Saskatchewan is for a more arid climate. Only the Peace River area of Alberta will gain as the poorer soils in the more northerly areas will not support extensive cereal crops. Finally, warming in Canada's north will be more pronounced than it is to the south. One of the big problems is that the enormous amounts of methane which are trapped in the arctic permafrost could be released to the atmosphere as the permafrost melts, thereby accelerating the pace of global warming.

CLIMATE CHANGE AND IMPLICATIONS FOR WILDLIFE

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NOTE: The following text has been prepared by session chairperson Miles Scott-Brown based on a summary provided by the participant.

Let us examine what effects global warming will have on the rest of the world. By 2050 A.D., there will be a massive flooding of our coastal areas; Bangladesh and Holland will be under water. New shorelines will result and there will be an extensive displacement of people. Our forested areas will become drier and extensive forest fires will result. This will in turn release more carbon dioxide to the atmosphere in a vicious circle. There will be a capricious relocation of weather patterns and intensified storm activity which could lead to increased soil erosion and agricultural degradation. Increased warming could result in a breakup of the world's ecosystems as happened during the Pleistocene with the result that there would be no bands of plant communities as we know them today.

Are these predictions valid? This may sound like a Doomsday Equation, but life will change drastically within Canada. As a result of warming, there could be a rapid increase of this country's population, possibly to 200 million people by 2050 A.D. May you live in interesting times!

And yet we are not prepared. We have agricultural policies that are in place that continue to allow for the growing of grain, even though those areas are now almost deserts. We have a policy of destroying what remains of our native prairie with no regard for the potential these species may have to offer as a result of their adaptation to a dry climate. Also we are losing our wetlands at an unprecedented rate, to the point that there may not be any left on the prairies in the next 50 years.

There are more serious threats to the survival of our wildlife than the greenhouse effect. Illegal trade in wildlife is decimating some species and legalized game ranching is the most serious threat to the future survival of our native North American ungulates. As for forestry, we have no effective policy of sustained production. Only 2% of old growth forests remain in the U.S. and determined efforts are underway to ensure the lasting conservation of what remains. Increasing road access into wilderness facilitates destruction of wildlife. Do not forget Chernobyl. There were three near miss nuclear disasters in West Germany during 1988 and we can predict that three more Chernobyls will occur within the next 25 years. Industrial pollution is rampant and toxic wastes have been implicated in the deaths of thousands of seals in the Baltic Sea. In short, the greenhouse effect is a small problem relative to some of the other threats to our global environment.

What can you do about the greenhouse effect? To begin, we need better communication about the environment between science and business. Individually, we need to reduce our material consumption. Perhaps we need a carbon tax; maybe we should pay to produce carbon dioxide. We have to place a price on the ecosystem, on live animals, live trees, on habitat; their value must be greater than their current market value. We need to reduce pollution, both individually and globally. Environment is a voting issue; we should let our politicians know what we think. We may be uncertain as to whether climate change is a fact; we need policies to deal with the change that will result. We need aggressive policies to establish ecological reserves and we need bridges of habitat between these protected areas. For some species, zoos may be the only bridge we have left. Finally, we need education for awareness of climate change and what it means to our lifestyle and how we may have to alter our lives to cope with it.

POLICIES FOR DEALING WITH CLIMATE CHANGE - WHAT CAN BE DONE?

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NOTE: The following text has been prepared by session chairperson Miles Scott-Brown based on a summary provided by the participant.

I want to provide a little more specific detail regarding the effects of climate change on the Canadian prairies. There has been a slight increase in mean temperature across the prairies since 1900. The exception to this is the period from 1940 to 1960 when temperatures were lower, perhaps as a result of volcanic activity. Last year was the third warmest year since 1882; several of the other warmest years on record have occurred in the last decade.

What effect will climate change have on agriculture, the mainstay of our western economy? The climate models that have been derived all agree that the increases in temperature due to the greenhouse effect will be accelerated in the winter months and at higher latitudes. Modest increases in precipitation could also occur, except possibly in the fall months. These precipitation increases, however, could be offset by an increase in evapotranspiration caused by higher temperatures. Under these conditions, agricultural losses of $163 million and about 700 jobs would result. This will lead to further spin-off losses in other sectors of the economy that depend on agriculture.

What can we do to cope with climate change on the prairies so that we are prepared for the possible results our models predict? The first is the need for more research to assess the impacts of climate change on agriculture. We also need more research on the effects of increased carbon dioxide on agriculture in combination with the effects of a warming climate. Secondly, our agricultural policy formulation and planning should be undertaken with the full awareness of the implications of a warming climate on agriculture. We should be communicating with farmers through agricultural programs to provide information that will allow them to take advantage of the benefits of climate change as well as trying to minimize the impacts of detrimental change. Finally, we need a full assessment of the costs and benefits to prairie agriculture of the predictions presented by climate models.

PESTICIDES AND WILDLIFE

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INTRODUCTION

Pesticides, which include insecticides, herbicides, and fungicides, are applied to crops primarily as sprays or granules. When they enter the environment, they immediately begin to break down by the action of sunlight or microbes in the soil and to disappear by evaporating and leaching through soil, depending upon solubility in water. Pesticides enter the bodies of exposed animals by inhalation, absorption through the skin, ingestion during preening of feathers or grooming of fur, and ingestion of contaminated plants, insects, or vertebrates. Most modern pesticides are rapidly metabolized by the liver and excreted mainly in the urine and, to a much lesser extent, in the feces. The standard measure of toxicity is the acute oral LD50, which is the single oral dose required to kill 50% of an experimental population of animals exposed to a range of doses. Toxicity through other routes of exposure, including absorption through the skin and inhalation, is also expressed as LD50 values. Animals that survive exposure to pesticides may suffer sublethal effects such as increased susceptibility to predation or abnormal parental behavior (Grue et al. 1983).

POTENTIAL AND KNOWN EFFECTS ON WILDLIFE

Direct Toxicity

Remnants of wildlife habitat in the prairies, consisting of native vegetation associated with wetlands or in road allowances and fence lines, tend to be targets for insecticide application, especially to control grasshoppers. Aerial application of pesticides greatly increases the potential for drift and results in direct overspray of wetlands because of the difficulty of avoiding small areas (Grue et al. 1986). The LD50 values of three of the six most commonly applied insecticides, carbofuran, dimethoate, and chlorpyrifos, indicate a high degree of toxicity to birds, whereas the other three (carbaryl, malathion, and deltamethrin) are relatively low in toxicity (Grue et al. 1986, Sheehan et al. 1987). Toxicity of insecticides varies considerably among species of bird; for example, Mallards (*Anas platyrhynchos*) and Red-winged Blackbirds (*Agelaius phoeniceus*) are 7 to 11 times more sensitive to carbofuran than are Ring-necked Pheasants (*Phasianus colchicus*) or Bobwhite (*Colinus virginianus*) (Eisler 1985).

Spraying for control of grasshoppers and the Russian wheat aphid, a potentially serious pest that invaded southern Saskatchewan and Alberta in 1988, takes place from mid-June through to mid-July. This coincides with the nesting season of many songbirds and ducks (Forsyth 1989). Thus, some Mallard and Blue-winged Teal (*Anas discors*) may have to walk their broods through sprayed vegetation to reach water soon after hatching (Sheehan et al. 1987). Other species that nest close to cropland may be exposed to insecticide sprays because they forage for insects in crops; for example, Western Meadowlarks (*Sturnella neglecta*), Mountain Bluebirds (*Sialia currucoides*) and Loggerhead Shrikes (*Lanius ludovicianus*). Alfalfa, attractive as nesting cover for waterfowl and other species of wildlife, is commonly sprayed with dimethoate or carbofuran when grown as a seed crop. Dimethoate has killed Sage Grouse (*Centrocercus urophasianus*) in alfalfa in Idaho (Blus et al. 1989); hence, its use in alfalfa should be monitored for adverse effects. Clay-colored Sparrows (*Spizella pallida*), Vesper Sparrows (*Pooecetes gramineus*), and Red-winged Blackbirds in a pasture near Moose Jaw, Saskatchewan, that was aerially sprayed with carbofuran at the rate of 140 g active ingredient (AI) per hectare in mid-June, survived and successfully reared their young to fledging (Anonymous 1989). On the other hand, carbofuran sprayed for grasshopper control in Saskatchewan has resulted in one known kill of 45 California Gulls (*Larus californicus*) and the disappearance of Burrowing Owls (*Speotyto cunicularia*) from their nest burrows (James and Fox 1987, Leighton et al. 1987). Insectivorous mammals such as Masked Shrews (*Sorex cinereus*) and grasshopper mice (*Onychomys leucogaster*) may also be exposed to insecticides in or near cropland. Foxes may be affected by eating carcasses of poisoned birds or small mammals.

The incorporation of granular insecticides into the soil with canola seed at planting time is often incomplete, resulting in deposit of granules on the surface where they are ingested by songbirds (Mineau 1988).

Relatively small deposits of granules can kill large numbers of birds because of the extreme toxicity of some products. For example, one granule of 10% carbofuran (Furadan 10G) per bird was sufficient to kill 100% of House Sparrows (*Passer domesticus*) tested, whereas five granules per bird were required to kill 80% of Red-winged Blackbirds; 15% granular terbufos (Counter 15G) was also very toxic to these species (Balcomb et al. 1984). A large kill of Lapland Longspurs (*Calcarius lapponicus*) occurred in a canola field treated with granular carbofuran in the spring of 1984 (Mineau 1988). The frequency with which songbirds are killed by granular insecticides in prairie cropland is not known, probably because there is no program in place to monitor for such kills. Farmers seldom visit their fields soon after seeding and carcasses of small birds are rapidly removed by scavengers. Birds of prey are known to have died from eating carcasses poisoned by granular carbofuran (Balcomb 1983).

Herbicides are generally very low in toxicity to vertebrate wildlife (Grue et al. 1986), but paraquat and trifluralin resulted in 50% mortality of Mallard embryos when applied to the eggs at the rate of 1.7 kg AI/ha (Hoffman and Albers 1984), which is three times the rate of paraquat and 1.5 times the maximum rate of trifluralin used in Canada. Paraquat has caused 23% mortality of Mallard embryos in eggs treated at 0.56 kg AI/ha (Hoffman and Eastin 1982), which is the rate registered in Canada for chemical summerfallow. Trifluralin is cultivated into the soil within 8 hours of spraying, but might affect eggs near agricultural crops by drifting into nests. Paraquat might be applied directly to nests in summerfallow in addition to drifting. Eggs of Ring Doves (*Streptopelia risoria*) are more sensitive to herbicides than are duck eggs (Hoffman and Albers 1984), but data for songbirds are lacking as are field studies for any species of bird.

Effects on Habitat

Aquatic insect larvae and amphipods are key food items for dabbling ducks during the first 2 to 3 weeks of life and for at least the first 7 weeks of life in diving species; hence, any pesticide that kills aquatic invertebrates is a potential threat to prairie ducks. Aerial application poses the most severe hazard, due to the likelihood of overspray and drift into wetlands. Synthetic pyrethroid insecticides, including deltamethrin, cypermethrin, and fenvalerate, and the organophosphate, chlorpyrifos, are extremely toxic to aquatic invertebrates (Sheehan et al. 1987). Deltamethrin applied aerially at the rate recommended for grasshopper control (7.5 g AI/ha) reduced populations of chironomid larvae by 99% within 11 days of spraying and ducklings living on the sprayed ponds showed signs of starvation (Morrill 1987). Chlorpyrifos, which is applied at rates up to 480 g AI/ha to prairie crops, has been shown to kill 90-100% of larval caddisflies and mayflies in ponds treated with only 56 g AI/ha (Macek et al. 1972). Deltamethrin is commonly sprayed for control of grasshoppers and cutworms in cereals and diamondback moth in canola, whereas chlorpyrifos is sprayed against grasshoppers, cutworms, orange wheat blossom midge, and Russian wheat aphid. The extent to which these insecticides are contaminating prairie wetlands and affecting invertebrate food supplies for aquatic birds is unknown and very difficult to determine.

Herbicides have the potential to adversely affect non-target plants important to wildlife for food or cover. A concentration of 0.1 mg/L of 2,4-D amine in pond water, simulating aerial application over shallow wetlands, caused growth suppression and mortality of submerged aquatic plants (Forsyth 1989). A recently registered sulfonyl urea herbicide, metsulfuron-methyl, controls Western Snowberry (*Symphoricarpos occidentalis*) when sprayed at the rate of 5 g AI/ha (Bowes 1987) and inhibits 77-90% of the growth of Sago Pondweed (*Potamogeton pectinatus*) when added to the water at 1 migrogram per litre (Chang 1987). This herbicide could affect shrubby nesting cover for waterfowl and songbirds and aquatic plants when it is sprayed on cereals at the rate of 4.5 g AI/ha, especially if aerial application is registered. No field testing has been carried out to determine the effects of herbicides on terrestrial wildlife habitat in typical prairie farmland. The Canadian Wildlife Service is initiating studies to assess the quality and utilization by birds of habitat closely associated with cropland in Saskatchewan.

Most herbicides in common use on the prairies are low in toxicity to aquatic invertebrates with the exceptions of 2,4-D ester and bromoxynil which show sufficient toxicity in laboratory studies to kill invertebrates in the water of ponds contaminated by direct aerial application. Trifluralin and triallate are also relatively toxic to aquatic invertebrates and can persist in sediments; hence, they may affect organisms by chronic exposure (Sheehan et al. 1987). Research is needed to determine the degree of contamination of prairie wetlands by herbicides, their persistence and effects on invertebrates.

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DEVELOPMENT OF DATABASES TO PROTECT THREATENED AND ENDANGERED SPECIES FROM PESTICIDE USE

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One of the roles of the pesticide program in the Canadian Wildlife Service is to identify as well as to minimize and/or prevent deleterious impacts on wildlife which might arise from the use of pesticide products. This is accomplished through a three phase program consisting of (1) pre-registration evaluation, (2) regulatory re-evaluation, and (3) post-registration monitoring and research. The latter phase is an avenue for identifying candidates for re-evaluation by assessing pesticides under actual use conditions and is an important element in the verification of risk assessments.

Consideration of the effects of pesticides on threatened and endangered species is necessary at all three phases. Until very recently this consideration had not been systematically addressed, especially in the pre-registration phase, primarily due to a lack of easily available information about threatened and endangered species in Canada.

Many of the species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) occur in areas where pesticides are used and are potentially at risk due to either direct toxicity of a pesticide or its modifying effects on criticial habitat. The magnitude of the problem is currently unknown. A recent study by Fox et al. (1989) on the impacts of insecticides on the Burrowing Owl (*Athene cunicularia*), a threatened species occurring in the prairie provinces, shows that a significant impact on survival and reproductive success occurred when nest burrows are directly oversprayed with the insecticide carbofuran.

As an intial step in protecting our threatened and endangered species from any further impact from pesticides, it is necessary to identify those species whose distribution and habitat utilization overlap with areas of pesticide use and whose life histories may place them at risk. In order to do this, databases were developed to allow biologists evaluating potential impact to identify species of concern more rapidly.

METHODS

Species Databases

Data were collected on the distribution and biology for all rare/vulnerable, threatened, and endangered species, as designated by COSEWIC before 1989. The baseline reference data were the status reports prepared by COSEWIC. As these reports are a summary of the status of the species at the time of designation by COSEWIC, they were viewed in this project as the authoritative reports except in cases where the report was outdated, significant further work had been done on the species, or pertinent information was missing. In addition, published and unpublished literature was collected and biologists working on each species were contacted, particulary for information on species location and population estimates.

Location data, whether range or site specific co-ordinates, were entered onto a micro-computer based SPANS^{TM} geographic information system. This allows the rapid production of maps on any one species or combination of species. In addition, a database was developed, using dBase III Plus, which contains a brief summary of the biology of each plant and animal species. This database is used as a screening tool to identify which species might be of concern due to their food source, habitat type, season, and location of egg-laying, etc. Should further species-specific information be required during the risk assessment process, the names and addresses of experts on each species are available on another database using dBase III Plus.

Crop Database

During the pre-registration phase of risk assessment, the proposed label for the pesticide is used to identify where the pesticide could potentially be used. The label states the type of crop and, in some cases, specific regions of the country for which registration is being sought. To determine where these crops are located, data on the location of 86 crops across Canada were obtained from Statistics Canada(1987), 1986 Census of Agriculture. These data were aggregated at the level of census consolidated subdivision, the finest level of resolution that census data can be publicly released. These location data were also entered on SPANS. This level of resolution was not fine enough to be useful in screening, particularly in northern areas of Canada where there is little agriculture. To increase the resolution of the crop database, agricultural ecumene files were obtained from Statistics Canada, which allowed elimination of areas of census consolidated subdivisions where no agriculture occurs.

Pre-registration Risk Assessment

During pre-registration risk assessment, SPANS can be used to overlay maps of species with maps of the crop(s) for which registration of the pesticide is requested. For those species where overlap with pesticide use occurs, the biology database is consulted to screen out those species whose biology will minimize or eliminate exposure. In addition, data on the toxicology and environmental fate of the pesticide submitted by the pesticide proponent are evaluated to identify levels of the pesticide that will potentially occur in various environmental compartments and groups of organisms (i.e. birds, mammals, fish, plants) which may be affected at those levels (data are not usually available to assess toxicity to amphibians or reptiles). These data are then used to determine which of the species exposed are potentially at risk as identified using SPANS and the species databases.

RESULTS

Several problems were encountered in developing and using the databases. Entry of data was a lengthy process as standard methods for recording species locations are lacking. Some location data are recorded in longitudes and latitudes, while others are in Universal Transverse Mercator, Legal Site Descriptions, etc. Considerable time is thus required to convert this information into a format compatible with SPANS.

For some species, particulary large mammals, whose distribution maps indicate large ranges, the geographic information system is of little help at the screening stage as these species appear potentially exposed to several pesticides being assessed. Knowledge of the habitat surrounding crops and the habitat utilization of these species is more useful than the mapping comparisons in these cases.

Risk assessment at the pre-registration stage is done on a case-by-case basis for specific registration actions on individual pesticides. This process is slow and may pose disproportionate limitations on newer pesticides, thus being inequitable in practice. The United States Environmental Protection Agency, after consideration of several approaches, has recently proposed an approach which ranks species on the need of protection (based on recovery potential, potential for exposure, etc.) and for each species, starting with those ranked highest, determines the potential risk due to all pesticides to which it is potentially exposed. Action is then taken on those pesticides posing a risk to the particular species (Federal Register 1989). In order to effectively use this approach in Canada, more information would be required on the specific locations of use for each pesticide; the crop location database is inadequate as it shows only areas of potential, not actual, use. Information on areas of actual use is confidential. Even if available, locations would vary over time, as consumer preferences and needs change, and the data would be very costly to collect in both time and money. So far in Canada the species specific, post-registration approach has been taken for only one threatened species, the Burrowing Owl (Fox et al. 1989).

Unlike the United States, Canada does not have a federally-legislated Endangered Species Act which, during the pesticide registration process, would ensure protection for threatened and endangered species and conservation of the ecosystems upon which they depend. It remains to be seen whether recommendations provided to the agricultural community concerning restrictions on use of certain pesticides due to risk to threatened and endangered species will be accepted.

ACKNOWLEDGEMENTS

The author wishes to thank W. K. Marshall for his ideas during the development of the project and Connie Downes and Heather Dewar for their hard work in collecting information and developing the databases.

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PESTICIDES SESSION - SUMMARY OF DISCUSSION

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The roles played by government, universities, and industry in determining the safe use of pesticides and implementation of alternative methods were discussed. Federal and provincial governments are not providing farmers with sufficient information about pest control methods other than use of pesticides. It was acknowledged that Agriculture Canada is carrying out research into biological pest control methods but the department places much more emphasis on use of pest control chemicals. Agriculture Canada should be providing incentives to industry to produce biological pesticides. Governments should be enforcing the existing label restrictions that are intended to protect the environment. Canada should consider implementing restrictions such as those in effect in the state of Washington where some herbicides are prohibited and some can only be used under a permit that requires the applicator to record the wind speed at the time of spraying. Spraying of pesticides by aircraft should be prohibited because of the increased risk to nontarget organisms. Students of agriculture in universities are taught the chemical approach to farming, without inclusion of alternative methods. Most of the employment available to graduates is in the pesticide industry, so the incentive is to learn the chemical approach. Industry should be working towards improving the window of pesticide application by the inclusion of methods to control spray drift, for example, by shrouds on sprayers.

Farmers use pesticides because they are forced to do so by the economics of modern agriculture. It may be possible for them to reduce their use of pesticides but not to eliminate them altogether. There was some feeling that all chemical pesticides should be eliminated because of their effects on the environment and because they were not essential to agriculture 50 years ago; however, there was not general agreement on these points. Organic farming was shown to be highly successful in a survey conducted in the United States during the early 1980s. A farmer claimed that his organic farm and others in Saskatchewan are more productive than conventional farms. The point was made that a major incentive to farm without chemicals, that of the premium price commanded by organic produce, might disappear if many farmers grew organically and flooded the market.

The Burrowing Owl (*Athene cunicularia*) can most effectively be protected from carbofuran spraying by prohibiting its use within the range of the owls. If we attempt to restrict its use on a piecemeal basis, we risk both outright noncompliance and accidental spraying of nest sites not known to the user. A piecemeal approach also increases the risk of threatened or endangered species being destroyed as a means of eliminating the problem. Canada does not have federal legislation to protect threatened or endangered species; such legislation would facilitate regulation of pesticides. Many farmers in Saskatchewan have shown their willingness to protect Burrowing Owls by requesting information about alternative insecticides to avoid using carbofuran.

Recommendations were made for research to determine (1) the physiological basis for variability among wildlife species in their sensitivities to pesticides, (2) the effects of pesticides, especially conservation tillage herbicides, on soil microflore and, (3) biological control methods.

DISEASE CONCERNS IN TRANSLOCATION, CAPTIVE PROPAGATION AND RELEASE OF WILDLIFE

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ABSTRACT

Translocation and captive propagation can be useful options in wildlife conservation efforts but they must be carefully evaluated in each circumstance before being implemented. They are not a substitute for good wildlife management. Most problems have arisen because of inappropriate rationale, insufficient planning, or lack of data. However, even with the best planning, unexpected problems can arise. Disease is not the only concern that must be evaluated in these programs.

In wildlife translocation projects, there is a risk of moving bacteria, viruses, and parasites that are in, or on, an animal. Animals with signs of disease or infestation should not be translocated. Animals can be asymptomatic carriers of disease agents which are ultimately harmful to their own and/or other species. A translocation project may also fail when healthy animals are moved to an area where a disease problem exists. Hence, it is important to have thorough information on the biology and health status of the species being moved and on the relocation site before the translocation takes place. From the outset, there should be a mechanism for monitoring a translocation project and contingency plans to deal with problems that may arise.

Captive propagation is sometimes necessary to save a species from extinction but it is a bleak alternative to preserving the animal in its natural environment. We should not be too willing to resort to captive propagation; some species adapt well, others do not. Infectious diseases are not the only health concern: genetic, nutritional, toxicological, and behavioral problems can affect the viability of these projects. If the goal of captive propagation is to eventually return a species to its natural environment, the program must not reduce the animals' physical, behavioral, and genetic ability to cope with reintroduction. Disease concerns mentioned in regard to translocation projects also apply to captive propagation projects when animals are to be returned to the wild.

MAJOR WILDLIFE DISEASES AS THREATS TO ENDANGERED SPECIES

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ABSTRACT

Many diseases occur in wild animals. Some of these occur regularly, kill large numbers of animals of many different species and must be considered significant potential risks to endangered species. Strategies to minimize the influence of such diseases should be part of all recovery and conservation programs. Four examples of these diseases are presented here.

Avian cholera is a contagious disease of wild birds caused by the bacterium *Pasteurella multocida*. It kills large numbers of waterfowl every year in North America and affects birds in winter, summer, and on migration. A very wide range of bird species is susceptible to this disease. Avian cholera poses a current threat to Aleutian geese on their wintering ground and to the Grays Lake population of Whooping Cranes (*Grus americana*) on migration through the St. Luis Valley of Colorado and on their winter range. The Piping Plover (*Charadrius melodus*) and Trumpeter Swan (*Cygnus buccinator*) may be at risk from this disease on the Canadian prairies.

Canine distemper is a contagious and lethal virus disease that affects several families of carnivores. This disease swept through the only known population of Black-footed Ferrets (*Mustela nigripes*) in the fall of 1985. It killed most of the ferrets captured for a captive breeding program and all of the ferrets remaining in the wild. This emphasizes how vulnerable small clustered populations of rare animals can be to disease.

Poisoning from ingestion of lead shot deposited in heavily-hunted habitats has killed 1 to 2 million ducks each year in North America for much of this century. All birds that ingest small hard objects while feeding on soil or marsh bottom are similarly at risk. Over the past decade, over 100 Bald Eagles (*Haliaeetus leucocephalus*) have been killed by lead poisoning as well. Bald Eagles are poisoned when they prey on dead or crippled birds that have lead shot embedded in their flesh. Peregrine Falcons (*Falco peregrinus*) are probably at risk as well. Lead shot for hunting waterfowl will be banned entirely in the United States by 1991 due to court rulings requiring protection of Bald Eagles from lead poisoning. Canada has yet to react to this situation.

Botulism is a poisoning that occurs when toxins produced by the common bacterium *Clostridium botulinum* are ingested. When an animal dies in a marsh, the bacterium grows in its decomposing flesh and toxin is produced. The toxin is concentrated in maggots developing in the carcass. Birds that feed on the maggots die of botulism and their bodies become the site for production of more toxin and more maggots. This cycle of events can cause massive mortality of birds in wetland habitats. One hundred thousand and more have died in single outbreaks. Botulism occurs regularly, year after year, at certain locations on the Canadian prairies and sporadically at others. Any bird that will feed on maggots is at risk from botulism.

DISEASE INTERACTIONS BETWEEN WILDLIFE AND DOMESTIC ANIMALS

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ABSTRACT

There have been relatively few problems involving transmission of diseases between wildlife and domestic animals in Canada. Some current problems include rabies in fox, skunk, and bat populations, brucellosis and tuberculosis in Bison (*Bison bison*) and giant liver flukes (*Fascioloides magna*) in Elk *Cervus elaphus*). Disease is a dynamic state and we are constantly altering the host, agent, and environmental parameters that affect the transmission and manifestation of diseases. Furthermore, the definitions of "wildlife" and "livestock" have become blurred, especially with the development of game farming. Commercial trade between zoos and game farms and intensive management of traditional livestock species, game-farmed wildlife and free-ranging wildlife in close proximity to one another have created new epidemiological bridges between populations that were once relatively isolated. We may fail to recognize transmission of disease agents between wildlife and domestic animals simply because of the difficulty in monitoring wildlife health.

Predicting potential disease transmission problems might be done by simply determining which diseases are present in both wildlife and domestic animal populations. However, this may be misleading since some subspecies or strains of a disease agent may prefer one host species over another and the agent may cycle independently in different host populations. A second means of predicting disease transmission problems is by monitoring events in other countries. For example, the New Zealand deer-farming industry may be a useful model for predicting future disease transmission problems between captive and free-ranging deer populations and conventional livestock species in Canada.

Several diseases named in the Animal Disease and Protection Act can be transmitted within and between wildlife and livestock populations with devastating effects on both. It is especially important that agriculture and wildlife agencies cooperate with each other to protect wildlife and livestock from the introduction and/or spread of these diseases.

DISEASE CONSIDERATIONS IN HABITAT CONSERVATION AND MANAGEMENT

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ABSTRACT

Conservation and maintenance of habitat is essential to any program of wildlife conservation. There is a strong relationship between the quantity and quality of habitat and the health of the animals that live within it. Evaluation of habitat must include an examination of the major hazards to wildlife health that may exist or develop later. Three examples of habitat criteria that affect wildlife health are quality of water, existing and potential pollution, and the population density of animals that is expected in the habitat.

Water quality has emerged as a major problem in wetlands over much of western North America. Devastating effects of pollutants from agricultural runoff and other sources have been documented in California and Nevada. Salinity of water also can render water toxic to young birds and prevent reproduction on otherwise rich and productive wetlands. Most water allocated to wetland habitats is waste water used for other purposes several times previously.

Pollution of various kinds can affect all types of habitat and is well recognized as a cause of disease in wildlife. Pollution comes in many forms and any assessment of habitat quality must include a careful review of existing and potential pollutants.

There is a strong relationship between the risk of disease and crowding of animals on too little habitat. Crowding greatly favours the spread of infectious agents among animals and is often accompanied by stress and poor nutrition which reduces the resistance of animals to disease. Thus, there must be a balance between the quantity of habitat available and the number of animals using it. Disease may help restore this balance but, in the process, small numbers of rare species may be extinguished.

It is possible to reduce the risk posed by disease through careful planning and management. The first step in any such plan is to *assess the risk*. Risk is a function of the *susceptibility* of animals to various diseases and the *exposure* of these animals to the various causes of the diseases. There is a sufficient knowledge base regarding diseases in wildlife to make such risk assessment possible. Once major risk factors have been identified, it may be possible to reduce risk by strategies that avoid disease and/or that prevent disease. Preventive measures may range from habitat management such as careful maintenance of water levels to actual medical intervention with vaccines or drugs as has been done with rabies in foxes and pneumonia in Big-horned Sheep (*Ovis canadensis*).

DISEASE AND ENDANGERED SPECIES CONSERVATION: SUMMARY DISCUSSION AND RECOMMENDED ACTIONS

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INTRODUCTION

The formal presentations made at this working session provided background and examples of how disease can significantly hinder endangered species recovery programs. In addition, disease was shown to affect whole assemblages of species within certain habitats. Disease was defined broadly to include all departures from normal health and included poisonings and non-infectious as well as infectious diseases. It is often possible to identify major risk factors associated with disease in a given recovery program or effort in habitat conservation or restoration. Furthermore, steps can often be taken to reduce the risk from disease in these settings.

At the working session, there was a broad consensus that the potential impact of disease should be considered in the planning stages of all projects involving recovery or re-establishment of endangered species and the conservation or reclamation of land for wildlife habitat. Several examples of disease problems in such programs were brought forward. It was widely agreed that management of wildlife and wildlands throughout most of Canada is unavoidable. Thus, disease must be managed as other factors in the ecology of wildlife are managed. It was the broad consensus that the kinds of disease management activities outlined in the formal presentations should be routinely undertaken.

RECOMMENDED ACTIONS

Captive Propagation and Release of Endangered Species

The following questions should be answered for each project undertaken: What important diseases are present in the captive propagation facility? What important diseases may be carried into the wild by the species in question when that species is released? What important diseases to which the species of concern is susceptible are present in the environment of the release site or the migration range? These questions should be answered, to the extent possible, in the planning stage because the answers may assist important decisions such as the location of the propagation facility and the location of release sites.

Translocation of Animals

In any situation where wild animals are to be moved from one geographic location to another, a full inventory of important diseases present in the animals to be moved and present in the environment to which they are being moved must be made. If it is likely that serious diseases will be translocated with the animals or that the animals will be moved into an area containing an important disease to which they are susceptible, the translocation effort may require re-evaluation, medical intervention or abandonment.

Domestic Animals and Wildlife

Diseases present among domestic livestock or that may affect domestic livestock must also be considered in release, translocation, and conservation efforts. There are relatively few diseases of major concern that are transferable between domestic and wild animals. Persons planning translocation and release activities should be aware of the Animal Disease Protection Act and the important protective network against the importation of potentially devastating diseases that would affect both domestic and wild species provided by Agriculture Canada within the context of this Act. Cooperation and consultation with Agriculture Canada and provincial Agriculture personnel is essential.

Risk Assessment in Habitat Conservation and Wildlife Management

It is possible to assess the risk posed by disease to projects involving endangered species conservation or general habitat conservation or improvement. Such risk assessment should be undertaken in the early planning stages of all such projects. This is true whether the concern is for the impact of disease on a particular species or the general occurrence of major diseases affecting a broad range of species on a given habitat. Furthermore, it is possible to integrate disease management into all such plans to reduce the impact of disease. Habitat parameters such as water quality and potential pollution must be considered in this context.

All of the above require that persons with specific training and expertise in wildlife diseases be made part of the planning and management teams for all projects of species and habitat conservation. This expertise is readily available. The information required for risk assessment and decision-making regarding the impact of disease will be available and adequate in some situations and deficient in others. It was recognized in the discussion that more information about diseases in wild animal populations is needed, including long-term records of occurrences of disease and surveillance as the pattern of occurrence and importance changes over time. It was noted that the proposed Cooperative Wildlife Health Laboratory, agreed to by Canada's four veterinary colleges and the federal, provincial, and territorial wildlife ministers, would make a substantial contribution to endangered species and habitat conservation through systematic records, surveillance, and specific advice and information.

ECONOMIC VALUES OF WILDLIFE: DEFINITIONS, MAGNITUDES AND POTENTIAL BENEFITS TO WILDLIFE

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INTRODUCTION

The use of environmental economics is usually associated with project development and resource production scenarios. However, it is now recognized that economic analyses can play an integral role in policy formation affecting the preservation of wildlife and endangered species (Bishop 1980, Phillips 1983). Wildlife economics has made significant research accomplishments and can be an important tool in wildlife management (Davis 1985). For example, economic values of wildlife can be used in detailed benefit-cost analyses of development projects requiring habitat alterations. The purpose of this paper is to discuss the various ways wildlife can be valued in an economic sense, describe the magnitude of these values in wildlife tourism, and consider how this momentum can be channelled to benefit wildlife.

ECONOMIC VALUES OF WILDLIFE

Wildlife generates a number of associated values, many of which can be monetarily measured (Loomis and Walsh 1986). Of these, economic values can be looked at in terms of expenditures resulting from an activity (economic impact) or value generated from the enjoyment of that same activity or wildlife species (economic efficiency). Expenditures on wildlife-related activities are useful in determining local or regional economic impact but do not measure the full economic value of wildlife (Davis 1985). Economic value can be measured by aggregating each user's consumer surplus from the use of a wildlife species.

With any measure of value, consumer surplus refers to the amount of benefit gained, measured by willingness to pay above and beyond actual expenditures. This is a difficult concept to understand because there is no actual outlay of money for consumer surplus (Loomis et al. 1984). For example, when a bird watcher pays an annual national park entrance fee of $20 to view wildlife, he/she may gain utility amounting to more than $20. Consumer surplus is the proper measurement of net benefit from a recreational activity on a particular site because this is what would be lost if the activity no longer occurred. This is also called net economic value or net willingness to pay (Sorg and Loomis 1984). Gross willingness to pay is the sum of expenditures and consumer surplus. Economic value can be divided into use and nonuse values.

Use values include both consumptive (e.g., hunting and fishing) and non-consumptive (e.g., bird watching, wildlife photography and nature study) value and are generated when an individual uses wildlife in the current time period. Value resulting from vicarious consumption (e.g., reading books, viewing films, etc.) may also be thought of as a use value, even though no direct contact with wildlife occurs.

Non-use values are generated by possibilities for future uses of wildlife and are further divided into option and existence values. Option value is the willingness to pay to retain the possibility for future use, above expected consumer surplus (Option price is the sum of option value and expected consumer surplus. (Bishop 1982)). Option value may be exhibited by a bird watcher who is willing to pay for the protection of an endangered bird species with the hope of someday observing it. The relatively new concept of quasi-option value is the value placed on the possibility of additional information arising about the impact of various resource uses (Randall 1987).

Existence value is the willingness to pay for the preservation of wildlife resources. For example, a person would exhibit existence value if he/she contributed to Whooping Crane (*Grus americana*) preservation even though no personal use was expected. Existence values are generated by three distinct motives or forms of altruism (1) interpersonal altruism: value from others' use, (2) intergenerational altruism: value from future generations' use (or inheritance value), and (3) intrinsic altruism: value from just knowing the resource is preserved (Stoll and Johnson 1984). Any person can possess any or all of these values depending on his/her context. Both option and existence values depend highly on the extent of demand and supply uncertainty. For example, if House Sparrows were to be preserved instead of Whooping Cranes, the values would be substantially lower because House Sparrows (*Passer domesticus*) are more certain to survive in today's context.

CURRENT VALUES OF WILDLIFE IN NORTH AMERICA

Uses of endangered species in North America are generally non-consumptive, so the following discussion of wildlife tourism will be restricted to non-consumptive users. Overall, research has focused primarily on expenditures and use values of wildlife recreation activities. In 1981, 12.3 million Canadians (66.8%) enjoyed wildlife around their residences and 3.6 million (19.4%) went on primary non-consumptive wildlife-related trips (Filion et al. 1983). Primary trips resulted in $2.1 billion in expenditures (mostly on equipment and transportation) and $400 million in direct economic benefit (i.e., use value). Residents of the prairie provinces spent $566 million on non-consumptive activities in 1981, resulting in a total use value of $83 million (compiled from Jacquemot et al. (1986)). The Alberta government has stressed the significance of this industry because it is renewable, creates jobs, generates money in areas with few economic opportunities, and increases government revenues (Alberta Fish and Wildlife 1984).

Other studies in North America indicate the extent of wildlife's economic value. In 1971, Horvath (1974) found that the use value received by participants from wildlife enjoyment in the southeastern United States averaged $71 per day and totalled $12.3 billion US. In southeastern Arizona, visitors to popular bird watching sites in 1977 placed an average use value of $79 US per day on their experience (Richards 1980).

Specific estimates of non-use values associated with wildlife are very limited. Stoll and Johnson (1984) estimated various values associated with the Whooping Cranes at Aransas National Wildlife Refuge, Texas. Total use value for visitors to Aransas in 1982 was $213,340 US (or $4.47/person). Combined option price and existence value for Whooping Cranes by refuge visitors was estimated to be $779,382 US (or $16.33/person). For Americans in general, this estimate ranged from $0.57 to $1.58 billion US, based on a national mail survey.

ECONOMIC VALUES OF BIRD WATCHING

Bird watching is one of the fastest-growing leisure activities in North America and I estimate that the sport's economic impact each year is in excess of $25 to 30 billion CDN in North America (based on Butler (1984), Jacquemot and Filion (1987) and Hvenegaard (1988)). Point Pelee National Park, Ontario, one of the most desirable locations in the world for the spring passerine migration, draws over 16,000 bird watchers each May. In May 1987, these birders spent over $2.1 million in the nearby Leamington area, primarily on food, accommodation, travel, and souvenirs (Butler and Hvenegaard 1988). Each bird watcher placed an average daily use value of $76 on their experience, which totalled $4.1 million in May 1987. Existence and inheritance values were also estimated by asking May bird watchers how much they were willing to contribute to the preservation of their most sought-after bird species. The average response was $263 for intrinsic existence value and $297 for inheritance value.

Approximately 10,000 bird watchers visited the famous swallow roost at Pembroke, Ontario in 1986, receiving $35,400 in net benefits (i.e. use value (Clark 1987)). This estimate served as the basis for a benefit-cost analysis which led to the eventual protection of the site in the wake of other proposed development projects. Similar estimates of economic value provide critical input in the decision-making process for particular land or wildlife issues.

On the prairies, economic values of wildlife are illustrated by the numerous wildlife tours offered to view wildlife and endangered species. Organized tours to see Whooping Cranes in central Saskatchewan, raptors in southern Alberta and Bald Eagles (*Haliaeetus leucocephalus*) in Montana are but a few examples. The community of Tofield, Alberta, now promoting Beaverhill Lake as an international birding destination, will benefit economically from an increase in wildlife tourism. Clearly, wildlife, and endangered species in particular, are important assets which generate significant economic values.

BENEFITS TO WILDLIFE

The number of non-consumptive users of wildlife (which can also include hunters and fishermen) in

North America is significant and their resulting expenditures and economic values are equally astounding. Benefits derived from participants in wildlife recreation include learning and enjoyment, exercise from hiking and friendly competition with other wildlife viewers (e.g., bird listers), but how is wildlife affected by this interaction? Researchers have already shown that non-consumptive activities can have detrimental effects on wildlife (Boyle and Samson 1985); these need to be minimized. On the other hand, wildlife may benefit from wildlife recreationists who maintain conservation ethics which have developed from an increased awareness, understanding, and appreciation of wildlife. This may lead to another potential benefit to wildlife from users, that of increased funding for conservation and habitat improvement projects.

Even though there are many wildlife users and supporters in North America, there seems to be a shortage of public funding and manpower to implement programs intended to promote population recovery in endangered species and improve wildlife habitats. With the limited budgets of governments, which should not be responsible for all wildlife projects, surely it is in the interest of wildlife users to contribute to programs which protect endangered species and enhance wildlife recreation opportunities. A discussion of some characteristics of these users may provide a solution to the funding problem.

First, non-consumptive wildlife users, and bird watchers in particular, are among the most educated recreational user groups known (Butler and Hvenegaard 1988). As well, bird watchers tend to have high disposable incomes; Point Pelee bird watchers of 1987 had a mean household income 51% greater than the Canadian average (Butler and Hvenegaard 1988). Finally, bird watchers do contribute to conservation efforts but not through licence sales as hunters and fishermen do. For example, 91% of American Birding Association members belong and contribute to three or more conservation groups oriented towards non-consumptive activities and 54% contribute to five or more (Witter and Shaw 1979). This group provides substantial financial support to wildlife conservation but not presently to government programs.

These studies suggest that bird watchers and non-consumptive users in general are well-educated, are able to contribute and display an eagerness to support conservation groups and programs. However, they may be skeptical about contributing to or be unaware of government initiatives for wildlife. Therefore, more effective mechanisms need to be implemented and promoted so that this user group can be encouraged to assist in financing wildlife programs. The sale of wildlife stamps is an excellent example of one such mechanism and 44 American states are currently raising funds for habitat preservation through their own waterfowl stamps (Turbak 1989). In fact, the U.S. federal duck stamp has already raised over $326 million US, preserving 4 million acres (1.6 million ha) of waterfowl habitat. New York has even directed a portion of its wildlife stamp revenues to fund habitat work in Canada. These stamps have been successful because they have a high profile and contribute to specific habitat projects. Other examples of how funds can be raised for endangered species are through income tax checkoffs, direct donations, entrance fees, immigration taxes, sales taxes, and licences for non-consumptive users.

In conclusion, the economic benefits and values of wildlife preservation are enormous. However, wildlife users must translate this interest into societal and monetary support for wildlife and incorporate methods to minimize disturbance.

ACKNOWLEDGEMENTS

Thanks go to Mr. Doug Krystofiak for his constructive comments on the manuscript.

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A GLOBAL VIEW OF CULTURAL AND ECONOMIC USES OF BIRDS

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Dr. Diamond's presentation was based on the book that he co-edited and his article in Chapter 12 of the book. Readers are referred to the book referenced as follows:

Diamond, A.W. and F.H. Filion (eds.). 1987. The value of birds. Technical Publication No. 6, International Council for Bird Preservation, Cambridge, England.

WILDLIFE ECONOMICS WORKING SESSION - SUMMARY AND RECOMMENDATIONS

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The field of wildlife economics has recently arisen due to the increasing demand for wildlife resources and scarcity of many wildlife species. Wildlife has had many historical uses relevant to food, religion, and culture in addition to many current uses including indicating environmental quality, pest control, recreation, etc. At the same time, habitat destruction, hunting, and illegal trade have reduced the populations of many wildlife species to critical levels. In addition to these concerns, wildlife economics also addresses wildlife valuation, property rights, wildlife production, and wildlife tourism.

Solutions to wildlife conservation problems often require an integration of biological and human considerations (i.e., social, political, and economic factors). Of course, a sound understanding of a wildlife species and its habitat requirements is always required. Social and political factors are also important in determining the short- and long-term viability of preservation efforts. In addition, the measurement of economic values and impacts, in units comparable to alternative uses, is necessary for efficient evaluation.

Participation in wildlife recreation and tourism, in particular, is growing rapidly; associated economic values and expenditures are significant. Thus, wildlife tourism exemplifies potential economic returns from preserving wildlife and a method of generating interest and support for wildlife. However, the economic worth of these activities has received little research attention in the past and, as a result, has been underestimated.

The challenge of integrating wildlife economics into the scope of wildlife management necessitates a number of priority actions:

(1) Conduct research to document the economic impact and efficiency values related to endangered species and wildlife recreation in the prairie provinces.

(2) Conduct economic analyses to compare the costs and benefits of species preservation. The California Condor (*Gymnogyps californicus*), Red-cockaded Woodpecker (*Picoides borealis*) and other species have been examined in this respect in the United States.

(3) Inventory and evaluate opportunities for wildlife supporters to contribute to specific wildlife projects.

(4) Government lobbying to encourage manpower and budget allocations which accurately reflect the various uses and values of wildlife.

(5) Conduct research to understand nonconsumptive users and their expectations so that satisfaction can be maximized. This will lead to enhanced marketing and promotion efforts along with more successful enjoyment and education results from government and private sector initiatives.

(6) Encourage wildlife tourism programs to attract, along with committed wildlife supporters, the so-called "middle ground" or segment of the population that, with a little prodding, may become wildlife supporters.

(7) Insist on minimal wildlife disturbances from wildlife tourism. Generating a code of ethics for tour operators or wildlife observers would be helpful in this regard.

3. PRAIRIE CONSERVATION ACTION PLAN

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IMPLEMENTING THE PRAIRIE CONSERVATION ACTION PLAN IN ALBERTA

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Those of us with any involvement in the land use/resource planning arena are familiar with the many arguments marshalled to emphasize the value of the process of planning and to downplay the product. Perhaps the most oft-cited is the statement ascribed to Dwight D. Eisenhower, "Plans are worthless, planning is essential."

It is certainly not my intention to belittle the value of the process of producing plans but it seems to me that our eagerness to emphasize the value of the planning, rather than the value of the plan, is not unrelated to the inauspicious fate of many if not most plans. Plans, perhaps more so than any other kind of document, are quintessential dust-gatherers. Many are obsolescent before they are adopted, others are rapidly superceded by events, many more fail to capture the commitment and support necessary to make them effective. My argument, then, with respect to the Prairie Conservation Action Plan, is a blunt one - in the final analysis, the measure of success of this plan will be not in the amount of media coverage it receives or the number of people who have copies or the number of conferences and meetings we hold or the number of coffee tables it graces, but on the extent to which direction expressed in the plan is put into effect on the ground.

The Prairie Conservation Action Plan is a blueprint for prairie-wide conservation and management efforts to protect native prairie and parkland species, communities, and habitat. Easily said. The scope of this undertaking, however, is as broad as the prairies themselves. The plan encompasses everything from a habitat development project on an individual pothole to the way Canadian Wheat Board quotas are set. Jurisdictions, groups, landowners, and organizations affected by the plan include federal and provincial government departments with land management and administrative responsibilities, urban municipalities, regional planning commissions, local authorities, academia, and non-government organizations.

To add to this complexity, it is not only in the context of implementing the entire plan that this long list of jurisdictions and groups comes into play, but frequently in the carrying out of individual action recommendations. For example, a specific action recommendation of the plan advocates measures to secure and permanently protect native habitats on private lands. In Alberta, this can be pursued through federal/provincial initiatives such as the North American Waterfowl Management Plan and soil conservation programs, through provincial government programs such as those to retain critical wildlife habitat on private lands or to acquire lands, through the activities of provincial lending institutions (return of repossessed agricultural lands having conservation value) or through the activities of non-government organizations such as the Nature Conservancy of Canada or Ducks Unlimited. The task can be simplified or made more difficult by federal, provincial and municipal tax regimes, tax incentives and marketing board quotas or by local land use plans, policies and by-laws. In this situation, no one should be surprised to find much confusion or different actors working at cross purposes, even when pursuing similar objectives.

The big challenge then, if the Prairie Conservation Action Plan is to be implemented effectively, is not only for the various groups and jurisdictions involved to agree upon the goals of the Prairie Conservation Action Plan but also to establish effective ways of working together to achieve them. At this point, it may seem that we have already deserted the realm of pragmatism for that of faith. The level of cooperation and coordination required to do the job may seem unattainable to those who view the operation of Canadian federalism as a sort of gentlemanly war. In fact, the situation is rather more optimistic than it might appear. In the last few years, the amount of cooperation between different groups in the pursuit of conservation-related objectives has increased dramatically. The old single sectoral approaches are lapsing into obsolescence while cooperative and integrated resource management endeavors are proliferating. Cooperative ventures, in which different groups pool their resources to common ends, are becoming the norm rather than the exception. Ducks Unlimited can be given a large measure of credit for setting this example and the rapid spread of the cooperative ventures approach is testimony to its effectiveness. There are lots of Alberta examples:

(1) A program to designate natural areas encourages volunteer stewards to sponsor site designation and become involved in the management and protection of sites.

(2) A program to protect critical prairie and parkland habitats and species is jointly funded by a major non-government organization and a provincial government department. Administrative costs are covered by a grant from a major utility. Public representatives sit on the committee that steer the program and site habitat work will be conducted in cooperation with local groups and organizations such as local fish and game clubs.

(3) An irrigation district, a national non-government organization and a provincial government agency sign a cooperative ventures agreement to secure wildlife habitat. Some 35 projects encompassing some 8000 to 10,000 acres (3250-4050 ha) of wildlife habitat are in the concept stage. Examples include Walleye (*Stizostedion vitreum*) rearing ponds, wetlands for waterfowl production, and improved overwintering areas for pheasants, deer, and non-game species.

(4) A privately-owned grazing ranch comes on the market and is purchased by the provincial government. In a cooperative project involving federal and provincial levels of government, a major non-government organization, an irrigation district, an oil company, and a provincial fish and game group, the ranch has seen integrated development that has substantially increased its value from both a livestock production and wildlife conservation perspective.

With the implementation of the Prairie Conservation Action Plan, the Alberta government is embarking on an experiment. Building on our positive experiences with cooperative ventures on a program and project basis, the next logical step is being taken. At the news conference releasing the Prairie Conservation Action Plan in Alberta, the provincial government announced establishment of a Prairie Conservation Coordinating Committee,"...to ensure the goals of the plan are carried out.... The committee will consist of representatives of various provincial government departments and invitations for membership will also be extended to non-government organizations."

The Prairie Conservation Coordinating Committee is currently in the process of being set up and will likely hold its inaugural meeting this spring. In addition to provincial government departments and non-government organizations, its membership will include public interest groups, industry, agricultural organizations, federal agencies, regional planning commissions, other jurisdictions, and academia.

The committee will have a 5-year life span, tied to that of the Prairie Conservation Action Plan, and will be responsible for encouraging the effective implementation of initiatives identified in the Prairie Conservation Action Plan. It is anticipated that the committee will (1) be a forum for information exchange and cooperation between organizations with interests in or jurisdiction over prairie conservation initiatives, (2) periodically review the plans, projects, and programs of members to assess progress and integrate program efforts, (3) allow all members to share their experiences and strengthen mutual goals, (4) encourage all members to adopt their own initiatives tailored to meet the goals of the Prairie Conservation Action Plan, (5) review progress in implementing the Prairie Conservation Action Plan in Alberta, (6) identify gaps and recommend measures to fill them in such areas as inventory deficiencies or new program requirements, and (7) adopt media communication strategies as appropriate to ensure that significant initiatives and accomplishments are widely communicated publicly.

That is a fairly hefty agenda and if the Prairie Conservation Action Plan is to be implemented effectively, there is obviously a lot riding on the shoulders of this new committee. The key to its success will be the extent to which each member organization brings to the table a commitment toward prairie conservation initiatives and a willingness to work cooperatively to achieve them.

While the role of the Prairie Conservation Coordinating Committee will be to provide impetus to conservation initiatives and to promote information dissemination and program coordination, the actual delivery of projects will, of course, remain entirely the responsibility of member organizations. Within those organizations, there is a great deal already happening. Here is a brief sampling of some of the initiatives currently underway in my own department, Alberta Forestry, Lands and Wildlife, lest you are left with the impression that its all talk about future committees and no action.

(1) Since 1983 Alberta Public Works, Supply and Services has acted as a land procurement agency for the Fish and Wildlife division to acquire some 69 land parcels containing over 16,500 acres (6680 ha) of valuable wildlife habitat and 30 land parcels containing over 7900 acres (3200 ha) of habitat crucial to fisheries.

(2) The first natural areas site was designated by the Alberta Legislature in 1971. Since then over 100 areas have been designated. The intent is to protect relatively undisturbed sites with interesting biological and/or geological features for recreational and educational use. There are currently about 27 designated areas in prairie and parkland Alberta and about 23 additional sites identified as Candidate Natural Areas.

(3) In a pilot initiative to secure critical wildlife habitat on patent lands in prairie and parkland Alberta, the Fish and Wildlife Division has been negotiating contracts with landowners to preserve habitat in two counties and two irrigation districts. Currently over 16,000 acres (6500 ha) of critical habitat are under agreement.

(4) The Public Lands Division is involved in a special pilot project employing satellite imagery and Geographic Information Systems technology to overview some 3.0 million acres (1.2 million ha) of native range under grazing lease in southern Alberta. This regional range inventory will allow management attention to be focused on areas of poor range resource condition. The ultimate intent is to implement sound, sustainable range management practices on all public prairie rangelands thereby ensuring that healthy, native-grass prairie ecosystems are maintained in perpetuity.

The future prognosis looks both bleak and hopeful, depending on one's personal level of optimism and on how one reads the signals. On the bleak side, native prairie and parkland environments in Alberta are rapidly being lost. As the settled portion of the province, these ecoregions have not only historically undergone the transformation from native ecosystems to agricultural and urban environments but continue to undergo depletion and modification by human activity at a considerable rate. Between 1950 and 1975, the County of Red Deer lost 50% of its habitat base. In the irrigation districts, the annual rate of loss of critical wetland habitats has averaged about 5% throughout the 1980s. In the 1970 to 1986 period, one irrigation district lost 74% of its wildlife habitat. Recent drought has exacerbated the problem. 1988 in southern Alberta saw much depressed waterfowl populations with many potholes dry and total duck populations down almost 30% over the 30-year average. Antelope kid production was down about 50% in the Suffield area and about 30% over southern Alberta as a whole. Native range was especially hard hit. Some ranges were not used at all, cattle were removed early from some provincial grazing reserves, many fires burned off considerable amounts of range and other areas had very low production; there will be minimal carryover into 1989.

On the bright side of the picture, society's environmental consciousness appears to be on the upswing again, enjoying a resurgence of public and political support. The sheer number of action-oriented conservation initiatives being undertaken by non-government organizations and governments is at an all-time high. Again, to take Alberta Forestry, Lands and Wildlife as an example, there are currently well over a dozen major program initiatives underway contributing directly to the goals and intentions of the Prairie Conservation Action Plan. Perhaps most positive of all, there is an apparent maturing in the climate of interaction between groups whose relationships have too often been adversarial. Nowhere is this better exemplified than in the various cooperative conservation ventures being pursued by governments and non-government organizations and by agricultural and conservation interests.

IMPLEMENTATION OF THE PRAIRIE CONSERVATION ACTION PLAN IN MANITOBA

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On 29 November 1988, Manitoba Premier Gary Filmon officially endorsed the Prairie Conservation Action Plan for implementation in Manitoba. The initial review of current or follow-up actions among Department of Natural Resources staff has been completed and forms the basis for my comments at this workshop. There are a few things that we have done or are currently doing in Manitoba. However, most of what I have to present for each of the 10 goals is tentative and are mere suggestions at this point. Staff time and financial resources will have to be added as the next step in this process. Finally, we shall have to decide what can be effectively implemented in fiscal 1989/90 through our Annual Branch program review process. Although we are already pressed for time, I am optimistic that Manitoba can achieve meaningful results for conserving prairie by 1994.

GOAL 1.
IDENTIFY THE REMAINING NATIVE PRAIRIE AND PARKLAND

(1) Tall Grass Prairie: The inventory of the historic range will be completed by 1 July 1989. All possible sites in the peripheral range will be identified by 1990.

(2) Mixed Grass Prairie: A list of existing protected areas will be prepared by 1990. Unprotected areas thought to be important will be identified by 1990.

(3) Parkland: Topographic and forest inventory maps will be examined to identify suitable sites by 1990.

(4) Provision of site and inventory information to user groups through the Resource Allocation Branch, Habitat Enhancement Landuse Program (H.E.L.P.), Ecologically Significant Areas Program, and wildlife cooperators.

(5) Managers will be given opportunities to participate in seminars, etc. such as Endangered Species Workshops, Department of Natural Resources Seminars, the North American Prairie Conference in 1992, and meetings of the Union of Manitoba Municipalities, Agriculture representatives, weed supervisors, and the Manitoba Natural Resources Officer Association.

GOAL 2.
PROTECT ONE LARGE, REPRESENTATIVE AREA IN EACH OF THE PRAIRIE ECOREGIONS

(1) Tall Grass Prairie: Sites in Winnipeg and the Oak Hammock Wildlife Management Area are now secured. Potential sites in southeastern Manitoba have been identified.

(2) Mixed Grass Prairie: An example is protected in the Shilo Military Reserve. The "Poverty Plains" area is being considered for protection.

(3) Aspen Parkland: Riding Mountain National Park preserves an example of this ecoregion.

(4) Fescue Prairie: Riding Mountain National Park and Duck Mountain Provincial Park area preserve examples of this ecoregion.

GOAL 3.
ESTABLISH A SYSTEM OF PROTECTED PRAIRIE ECOSYSTEMS WITH CONNECTING CORRIDORS

(1) New Ecological Reserves Directory will assist,

(2) Consider a system of incentives for protection of all existing prairie and parkland by 1994,

(3) Expand extension program to include a brochure on Native Prairie Management, H.E.L.P., P.F.R.A. Permanent Cover Program, Manitoba Soil Accord, and Grassland Program of the Department of Agriculture,

(4) Prepare Management Plans for riparian ecosystems including the Assiniboine River corridor, Souris

River Bend, Lauder Sandhills, Spruce Woods Provincial Park, and Beaudry Park.

GOAL 4.
PROTECT THREATENED ECOSYSTEMS BY IMPLEMENTING HABITAT MANAGEMENT AND RESTORATION PLANS

(1) Build in Prairie Management Components to all Crown Land Management Programs,

(2) Hire a prairie specialist in the Department of Natural Resources,

(3) Hire a range manager at Shilo Military Reserve.

GOAL 5.
PROTECT AND ENHANCE ENDANGERED PRAIRIE SPECIES WITH RECOVERY AND MANAGEMENT PLANS

(1) Participate in RENEW, a committee responsible for the REcovery of Nationally Endangered Wildlife,

(2) Prepare Recovery Plans for nine endangered species,

(3) Consider reintroduction of three extirpated species,

(4) Continue efforts to recover Peregrine Falcons (*Falco peregrinus*), Burrowing Owls (*Athene cunicularia*), and Piping Plovers (*Charadrius melodus*),

(5) Approve an Endangered Species Act in 1989,

(6) Obtain support from non-government organizations and ESRF.

GOAL 6.
NO ADDITIONAL SPECIES BECOME THREATENED OR ENDANGERED

(1) Protect important shorebird staging areas,

(2) Evaluate candidate species unique to Manitoba,

(3) Participate with the Department of Agriculture on program planning.

GOAL 7.
ENCOURAGE GOVERNMENTS TO INCORPORATE PRAIRIE CONSERVATION IN THEIR PROGRAMS

(1) Support for a Manitoba Conservation Strategy is firm,

(2) Create a task force to train staff of the departments of Agriculture and Natural Resources in the merits of prairie conservation.

GOAL 8.
ENCOURAGE BALANCED USE OF PRIVATE LANDS

(1) Review and recommend adjustment of municipal taxation procedures,

(2) Acknowledge the efforts of current landowners through Wildlife Cooperator Awards, Habitat Trust Program, H.E.L.P., and the Ecologically Significant Areas Program.

GOAL 9.
PROMOTE PUBLIC AWARENESS OF PRAIRIE WILDLIFE AND WILD PLACES

(1) Continue existing facilities and programs such as the Living Prairie Museum, Omand's Creek, Fort Whyte Nature Center, Oak Hammock Wildlife Management Area, and Beaudry Park,

(2) Support volunteer involvement in wildlife work by the Manitoba Naturalists Society, friends of parks societies, Ecologically Significant Areas Program, and Parklands Wildlife Federation,

(3) Promote Project WILD and Operation Lifeline,

(4) Prepare a prairie management handbook for landowners,

(5) Offer courses in prairie conservation at Manitoba universities and community colleges,

(6) Develop a prairie tour package with a Manitoba component.

GOAL 10.
PROMOTE RESEARCH RELEVANT TO PRAIRIE CONSERVATION

(1) Consider a Prairie Research Centre as part af the proposed Environmental Centre in Winnipeg,

(2) Encourage research on prairie, drought-resistant species in the Department of Plant Science at the University of Manitoba.

SASKATCHEWAN PARKS AND RENEWABLE RESOURCES' ROLE IN IMPLEMENTATION OF THE PRAIRIE CONSERVATION ACTION PLAN

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When Premier Devine released the Prairie Conservation Action Plan in Saskatchewan with World Wildlife Fund President Monte Hummel, he noted that this plan was prepared cooperatively and expressed the hope that a similar cooperative approach can be followed for implementation. Certainly my department cannot do everything suggested in the Prairie Conservation Action Plan, nor can the Government of Saskatchewan. If these ambitious goals are to be achieved, all levels of government, non-government organizations, and private individuals must work together.

We are already addressing a number of the goals of the Prairie Conservation Action Plan and initiating new actions to address these goals. The Terrestrial Wildlife Habitat Inventory identifies where native prairie and parkland remain in Saskatchewan. For any portion of agricultural Saskatchewan, a glance at our maps will tell you whether the area is native or cultivated. We are currently beginning to place this information on a computerized geographic information system to facilitate analysis and updating. However, the basic inventory called for in Goal 1 is complete. Indeed, the data which allowed preparation of the map in the Prairie Conservation Action Plan came from this inventory.

The only additional inventory which may be necessary is site-specific information on the type and quality of the vegetation present. For example, before choosing a site as a grassland reserve, you would want to ensure it has not been invaded by brome grass. That would require a visit to the site.

Last summer we signed an agreement with Parks Canada to create the Grassland National Park. This will create the large reserve called for in the mixed grassland ecoregion. Moose Mountain Provincial Park is a 154 square mile (399 km^2) reserve in the aspen parkland which I offer as the large reserve for the aspen parkland ecoregion. These two areas meet our needs to achieve Goal 2 of the Prairie Conservation Action Plan.

The department already plays a major role in protecting lands which can be the small reserves called for in Goal 3 of the Action Plan. The Parks Act protects 103,638 acres (41869.8 ha) including protected areas and recreation sites. While some of these areas are developed, large areas are natural. They can have a very high level of protection through zoning and offer a core of well-protected areas which are an essential part of the small reserve system. Wildlife lands and other department lands are also protected and add to this core of protected areas.

The goal of having 10% of each habitat subregion under some form of protection will not be achieved in most regions through parks and ecological reserves. Areas of native vegetation which are used for agriculture but are not cultivated will be an essential component of the small reserve network. The 1.85 million acres (747,400 ha) of crown grazing lands currently designated under the Critical Wildlife Habitat Protection Act may not be sold or broken, but continue to be used for haying and grazing. They provide a major contribution to the system of small reserves and, as Premier Devine said in December when releasing the Action Plan, "We can do more."

Nonetheless, I must point out that our mandate calls for us to manage habitats for species and other particular functions. The Department of Environment has a broader mandate with the Ecological Reserves Act and will also play an important role in working toward Goal 3. Meeting this goal will also require working with private landowners, a task which may be handled most effectively by private groups such as the Saskatchewan Wildlife Federation. The Federation already has a series of programs, such as acres for wildlife, designed to protect privately-owned habitats.

The department has endorsed and committed itself to the RENEW process for managing endangered wildlife. We shall be cooperating with Canadian Wildlife Service and the other provinces to establish recovery teams and prepare and implement recovery plans for threatened and endangered wildlife. We are also developing recovery plans for species which are threatened in a provincial context but have not been designated nationally.

Last year we extended the protection of *The Wildlife Act* to the Prairie Rattlesnake (*Crotalus viridis viridis*), Eastern Short-horned Lizard (*Phrynosoma douglasi*), and Eastern Yellow-bellied Racer (*Coluber constrictus flaviventris*), three species which we felt need protection. Operation Burrowing Owl (*Athene cunicularis*) and the Swift Fox (*Vulpes velox*) reintroduction are two of what will be a growing number of recovery programs.

The World Wildlife Fund has been an important cooperator in these endangered species efforts through the last 3 years of the Wild West program. The new $300,000 Saskatchewan Endangered Species Fund announced by Premier Devine and World Wildlife President Monte Hummel in December will greatly facilitate this work. We expect to have the fund ready to support projects this spring.

The Action Plan recognizes the importance of working with private landowners to maintain biological diversity and sustainable use of the land. The Premier has indicated that the government will be making changes to some agricultural programs, such as crop insurance, to ensure that programs help maintain sustainable farming without working against conservation of soil and wildlife.

The Department of Agriculture is also developing soil conservation initiatives. Our wildlife programs will work with these soil conservation initiatives to broaden their conservation impact.**is a very important approach toward implementation of the North American Waterfowl Management Plan.

I was pleased to see recognition in the Action Plan that public awareness and education are essential ingredients for success in conservation. We began introducing Project Wild to Saskatchewan schools 3 years ago. It has been very well received. We are currently hiring a full time coordinator for our wildlife education programs which will increase our ability to reach the school system. The programs at the Museum of Natural History are heavily oriented toward interpretation and education. Our parks act as outdoor heritage areas where the natural environment can be interpreted and enjoyed.

Earl Wiltse, our Regional Biologist in Regina, has just returned to university to develop some expertise on urban wildlife programs. This may develop as an important new area for wildlife work.

We clearly have a series of programs which work to the goals of the Action Plan and we are developing more. Nonetheless, reaching the goals of this plan will take time. I believe the Action Plan must be incorporated into our departmental priorities to ensure it does not disappear onto the library shelves. Each of our branches will be preparing a plan for the 1990's. I shall be asking each Branch Director, as part of their planning process, to review how they can incorporate the goals of the Prairie Conservation Action Plan into their own goals and objectives for the 1990's.

Implementation of this Action Plan will not be done by this department alone. The government recently struck a Roundtable on Environment. We shall bring the Action Plan in front of other portions of the government through this committee to seek their cooperation.

To summarize, Saskatchewan Parks and Renewable Resources has been and is developing programs which will make substantial contributions to meet each of the goals of the Action Plan. I believe we have already met two of them. Nonetheless substantial efforts from other government departments and non-government organizations will be necessary to achieve all the objectives in this plan.

HOW THE ACTIVITIES OF DUCKS UNLIMITED CANADA FIT THE GOALS OF THE PRAIRIE CONSERVATION ACTION PLAN

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This paper discusses the activities of Ducks Unlimited Canada and how they fit the goals of the Prairie Conservation Action Plan. Ducks Unlimited projects have always supported more than just ducks. For over 50 years, marsh management techniques employed by Ducks Unlimited (D.U.) have preserved and enhanced diverse wetland ecosystems. Considering our increasing involvement with upland habitat, even more "common ground" is being shared with other conservation interests. A review of the goals of the Prairie Conservation Action Plan reveals that six of the 10 share some degree of mutual interest with D.U. Canada activities.

Goal 1: Identify the remaining native prairie and parkland.

D.U. Canada has an extensive wetland habitat inventory using computer-processed satellite data to produce color-enhanced mapping. The capability to classify and map upland habitat is currently being developed.

Goal 4: Protect threatened ecosystems and habitats by preparing and implementing habitat and restoration plans.

D.U. Canada projects, and in particular Heritage Marshes with their upland component, implement habitat management and restoration that facilitates the preservation of endangered, threatened, and rare species throughout the prairies and parklands of western Canada. The Saskatchewan Heritage Marsh Agreement, signed in 1982, was a first. A cooperative effort involving the Government of Saskatchewan, Saskatchewan Wildlife Federation, Saskatchewan Natural History Society, Ducks Unlimited Canada, and Wildlife Habitat Canada, the program identifies and seeks to preserve the most important large wetlands in the province. Of the 20 wetlands identified for habitat restoration, four are completed, five are under construction and the remainder are at various stages of planning.

Manitoba has a similar program involving five Heritage Marshes and 10 candidate marshes. "Wetlands for Tomorrow" is Alberta's version of large marsh cooperative management. Of the 20 identified wetlands, one is completed and eight are under construction.

There are at least 6 species of concern, with three endangered species, including the Whooping Crane, that frequent such large marsh complexes. Several Saskatchewan D.U. projects and Heritage Marshes are important stop-over points during migration. The Piping Plover breeds at several Saskatchewan Heritage Marsh sites while the Peregrine Falcon has been observed hunting on the Chaplin Heritage Marsh on migration.

The prairie long-tailed weasel is one of two threatened species associated with large marsh developments. It utilizes riparian habitat year round on many Saskatchewan wetlands. The Burrowing Owl is known to nest at two native upland sites adjacent to the Luck Lake Heritage Marsh. Current efforts in native upland habitat securement, re-establishment, and management hold much potential for both of these threatened species.

The Trumpeter Swan, a rare species, breeds on two D.U. projects in southwest Saskatchewan. In the Grande Prairie region of Alberta, some 15 D.U. projects have design and management considerations specifically for this rare species.

The American White Pelican, recently delisted from rare status, breeds or frequents several D.U. projects and Heritage Marshes.

Goal 7: Encourage governments to more explicitly incorporate conservation of native prairie in their programs.

D.U. Canada has plans to work with both federal and provincial agriculture agencies in Saskatchewan to improve grazing systems on native pastures which include wetlands.

Goal 8: Encourage balanced use of private lands that allows sustained use of the land while maintaining and enhancing the native biological diversity of the prairies.

Our agricultural extension program includes conservation farming demonstrations which promote improved grazing systems. There are currently five demonstrations in Saskatchewan, all of which involve native pasture. We are also involved in an experiment with a soil conservation group to plant forage rhyzomes on soil which is too saline for seed germination. This technique could be useful in re-establishing native forage on saline land that otherwise grows nothing.

Goal 9: Promote public awareness of the values and importance of prairie wildlife and wild places.

D.U. Canada has a wide variety of public relations strategies. Although our theme is waterfowl and wetlands, other wildlife and the health of the land are strongly emphasized. A series of pamphlets promotes conservation for the farming community. The "Conservator" is a quarterly magazine which covers many aspects of wetland ecology for the general public. A variety of video tapes and films are available to the public for the asking. A brochure of D.U. activities in Saskatchewan has recently been published. Provincial brochures are also available for Manitoba and Alberta.

"Greenwing Days", for children under 16 years, are held near marshes; wetland ecology and general wildlife appreciation are promoted. Biologists make presentations to school children of all ages, both in the classroom and in the field. There are interpretive facilities on several D.U. projects and there is great potential for their development on Heritage Marshes.

D.U. presents displays at National Wildlife Week and in agricultural shows. We also attend agriculture field tours. Our fund-raising events appeal to a wide range of people; those contacted then receive follow-up information promoting conservation.

Recently, a television cartoon advertisement featuring D.U. Duck was developed. Our biologists do a wide variety of radio and television interviews. Media appreciation awards are sometimes presented for coverage that is particularly well done.

D.U. Canada encourages people to work together by becoming involved with other organizations including governments, wildlife federations, naturalists, farmers and industry. We participated in the 1987 Ramsar conference and the dedication of the Last Mountain Lake Area which encompasses several D.U. projects. More recently we have become involved with the North American Waterfowl Management Plan.

Goal 10: Promote research relevant to prairie conservation.

D.U. Canada supports research in marsh ecology at the Delta Waterfowl Research Station in Manitoba. The Alberta Implementation Strategy for the Prairie Conservation Action Plan included D.U. Canada in several cooperative ventures.

I hope that this paper has promoted the potential for increased cooperation not only throughout the prairie provinces but also with respect to the type of opportunities available.

THE 1988 GRASSLANDS NATIONAL PARK AGREEMENT

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INTRODUCTION

On September 23, 1988 the Honourable Tom McMillan, then federal Minister of the Environment, and the Honourable Colin Maxwell, Minister for Saskatchewan Parks, Recreation and Culture, signed An Agreement for the Establishment of a National Park in the Val Marie-Old Post Rural Municipalities of southern Saskatchewan. The agreement does not create a new national park; to this date, there is no federally-legislated national park in the grasslands area of Canada.

A new national park can only be created by federal legislation. Prior to Bill C-30, a new national park had to pass through the House of Commons. With Bill C-30, the federal cabinet can approve the creation of a new national park. Neither of those steps has been taken.

There are 17 sections to the agreement covering 10 main issues. An "escape clause" (Section 15) relieves Saskatchewan of its obligations under certain sections of the agreement if, within 30 years of the signing of the agreement, it provides Canada with one year's notice in writing of its intentions. This escape clause only applies to lands that Canada has not yet acquired freehold title. In the following summary of the 1988 agreement, sections of the agreement where the escape clause applies are indicated.

INTERPRETATION AND MANAGEMENT OF WATERCOURSES (SECTIONS 2 AND 8 OF THE AGREEMENT)

Watercourses are defined in the agreement as consisting "...of bed, banks and water, the flow of which need not be constant, the banks of which being further described as the line where vegetation ceases or where the character of the vegetation and soil changes" (Section 2.3). The agreement specifies that the watercourses will not form part of the proposed national park and that administration and control of the watercourses will remain with Saskatchewan (Section 8.1), subject to a joint review 10 years after the signing and every 10 years thereafter (Section 8.8). Watercourses are to be managed in a manner consistent with the management of the national park and both parties agree to cooperate to achieve that goal (Section 8.2). Within 6 months of the signing of the agreement, Saskatchewan will designate the watercourses as a Protected Area under the Saskatchewan Parks Act (Section 8.3). National park wardens will be empowered to enforce provincial regulations (Section 8.4). Access will not be impeded (Section 8.5). Section 8.6 states that neither party will, without prior written consent of the other, "...alter the flow or impair the quality of waters...by the construction of works or otherwise." A "notwithstanding clause" (Section 8.7) applicable to Section 8.6 allows alteration of flow or impairment of quality for (1) the requirements of gauging stations on the Frenchman River outside Core A (Fig. 1) to fulfil local needs and the international commitments of Canada under the Boundary Waters Treaty of 1909 and (2) the continuance and renovation of water projects licensed by Saskatchewan as of the date of signing.

OIL AND GAS RIGHTS (SECTION 3)

The agreements on oil and gas rights are subject to a joint review every 10 years and may be amended as part of that review process (Section 3.4). Saskatchewan will designate, within 6 months of the signing of the agreement, a Crown mineral reserve on the initial proposed national park lands (Section 3.1). The "initial proposed national park lands" are defined as those lands identified by Canada upon signing the agreement within the proposed national park up to a maximum of 130 square miles (336.7 km^2). Unfortunately, there is nothing in the agreement that outlines those lands, although a description of the lands has been provided to Saskatchewan by Canada. There are 116.75 square miles (302.4 km^2) of initial proposed national park lands in the West Block and 13.25 square miles (34.3 km^2) in the East Block, considerably less than the 188 square miles (486.9 km^2) of "core area" lands identified in the 1981 agreement. The "initial proposed national park lands" will not be subject to oil and gas exploration.

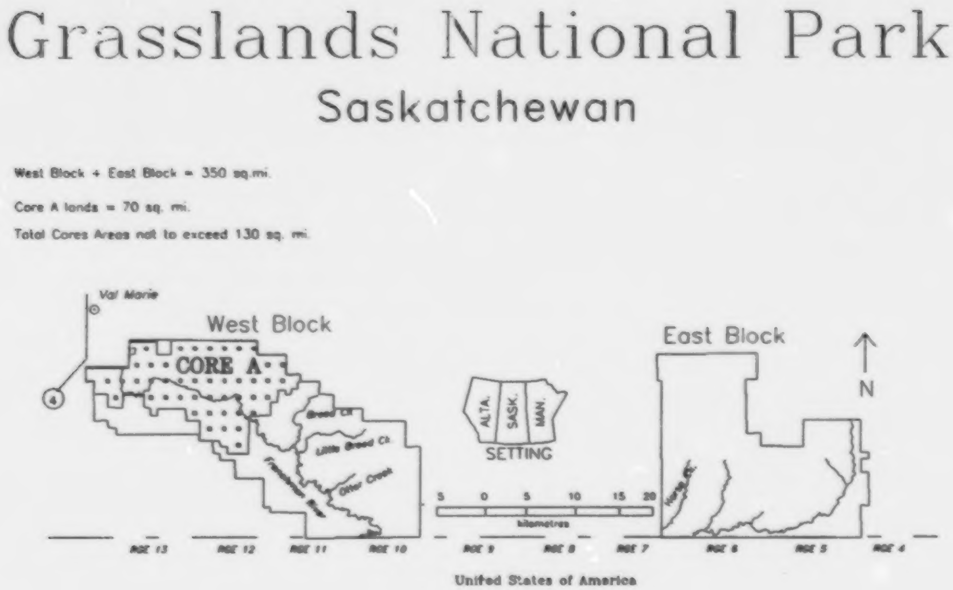
Grasslands National Park
Saskatchewan
West Block + East Block = 350 sq.mi.
Core A lands = 70 sq. mi.
Total Cores Areas not to exceed 130 sq. mi.
Val Marie
4
West Block
CORE A
Breed Ck
Little Breed Ck
Otter Creek
ALTA.
SASK.
MAN.
SETTING
5
0
5
10
15
20
kilometres
East Block
N
RGE 13
RGE 12
RGE 11
RGE 10
RGE 9
RGE 8
RGE 7
RGE 6
RGE 5
RGE 4
United States of America

FIGURE 1. Location of proposed Grasslands National Park in Saskatchewan.

For other lands within the proposed park area, Saskatchewan will offer exploration permits, with a maximum term of 3 years, within 9 months of the signing of the agreement (Section 3.3a). If an exploration permit is not issued within 9 months of the signing of the agreement, the land will be placed under Crown mineral reserve within 15 months of the signing of the agreement (Section 3.3b, subject to escape clause). If exploration shows marketable quantities of oil and/or natural gas, Saskatchewan will grant a 5-year term lease to a maximum of 75% of the permit area for development and production of the oil and/or gas (Section 3.3c). Lands for which a lease is not acquired will be placed under Crown mineral reserve within 6 months of the expiration of the exploration permit (Section 3.3d, subject to escape clause). Once actual production terminates, land will be placed under Crown mineral reserve within 6 months of termination of production or within 6 months of termination of the lease (Section 3.3e, subject to escape clause, and Section 3.3f).

Section 3.5 states that Saskatchewan will "...use its best endeavours to minimize the environmental impact of the exploration and development program...." Schedule F, attached to the agreement, states environmental surface protection objectives and guidelines for oil and gas exploration. The objectives are to: (1) preserve the prairie grasslands in as unaltered a state as possible, (2) preserve unique habitats (eg. prairie dog colonies) intact, (3) preserve unique landforms intact (4) preserve and protect historical and archaeological sites from the program and (5) limit the number of wells drilled to the absolute minimum. The guidelines for the program are to: (1) ensure that information about unique, fragile or important resources is gathered prior to the commencement of an exploration program, (2) conduct an environmental screening of the proposed park lands, (3) conduct site specific studies for each exploration or exploitation site, (4) develop mitigating measures to minimize the environmental impact, (5) develop measures to monitor environmental impact prior to the program commencing and (6) develop and implement a program for landscape restoration to its "...original, natural state once the program has been completed."

Detailed federal environmental protection criteria are not outlined in the agreement but presumably are to be developed, perhaps as part of the consultative procedure (discussed later under "Consultative Committee"). Furthermore, there is some confusion between the guidelines specified in Schedule F and Section 3 on oil and gas rights. As indicated above in the list of Schedule F guidelines, information on "unique, fragile or important resources" must be gathered prior to the commencement of the oil and gas exploration program. However, according to Section 3.3, there is a minimum 9-month period to issue oil and gas exploration permits starting on September 23, 1988. The Canadian Parks Service is not likely to begin its ecological inventory program for the proposed park before 1990. It seems impossible then that detailed data can be gathered for environmental protection purposes within the minimum time frame indicated in the agreement.

LAND ACQUISITION - TRANSFER AND COMPENSATION (SECTION 4)

Canada will acquire title to any freehold lands in the park areas on the open market on a willing buyer and seller basis and will assume control of surface and subsurface rights (Section 4.2). Canada may also acquire any third party rights or subsurface rights granted by Saskatchewan prior to the signing of the agreement (Section 4.3). Canada can, at its cost, also acquire leasehold interests in the park areas. Canada will compensate lessees who surrender leasehold lands prior to the expiration of a lease (Section 4.4). Canada will pay relocation costs to vendors (Section 4.7), the details of which are outlined in Schedule D. In spite of Schedule D, landowners and leaseholders in the park area are still unclear as to the compensation packages applicable to their parcels of land.

Canada can purchase freehold or leasehold lands outside proposed park boundaries if those lands fall within Townships 1 to 3, Ranges 4 to 13, West of the Third Meridian and are "...substantially related to ranching operations conducted within the park" (Section 4.8). Canada can then exchange those lands for lands within the park area (Section 4.9).

Both Canada and Saskatchewan agree that neither will allow exploitation of minerals within the proposed park area (Section 4.13, subject to escape clause), except as subject to the oil and gas exploration agreement (Section 3) and insofar as it does not affect any third party rights granted by Saskatchewan prior to the signing of the agreement. Saskatchewan agrees not to sell any land within the proposed park except to Canada with the proviso that any land use agreements entered into by Saskatchewan with parties prior to this agreement will be honored (Section 4.14, subject to escape clause).

Canada can enter into arrangements with non-profit, non-government organizations to help acquire freehold and leasehold interests (Section 4.15). For example, a combined Canadian Nature Federation and Nature Conservancy of Canada proposal has been developed to facilitate private funding for park land acquisition.

ACCEPTANCE OF LANDS AND PARK ESTABLISHMENT (SECTION 5)

The agreement provides no schedule as to when Canada will establish lands it acquires as a national park. Section 5.2 simply states that "...Canada will as appropriate, take such steps to provide for the establishment of the lands so accepted as a National Park of Canada...." We believe the park should be proclaimed immediately following its completion, preferably by the first anniversary of the agreement. Future boundary adjustments will be necessary as other lands are cleared for acquisition and addition to the park. However, we believe it is important for conservation purposes that Canada not wait until all lands are under federal ownership to formally establish the park.

REVERSION OF PARK LANDS (SECTION 6)

If Canada decides it no longer wants lands it has acquired for the park, they will revert to Saskatchewan at no cost (Section 6.1). If Canada exploits or permits exploitation of any mines and minerals on park lands, those lands will revert to Saskatchewan (Section 6.2).

ROAD ACCESS (Section 7)

Canada must provide freehold owners and lessees with alternate no-cost access to the nearest public road if the access of those owners and lessees is disrupted by Canada's acquisition of lands (Section 7.1). Canada agrees to develop, operate and maintain a public road that will connect the East and West blocks (Section 7.3).

CONSULTATIVE COMMITTEE (SECTION 9)

A consultative committee of federal and provincial officials will be formed to meet "...from time to time on matters relative to the park areas." That committee can establish subcommittees to deal with such matters as interim management and protection of the park areas, acquisition of proposed national park lands and cooperative planning and management of the park areas adjacent to the proposed park.

TOURISM AND RECREATIONAL PLANNING (SECTION 10)

Canada and Saskatchewan agree to consider an arrangement whereby Canada provides financial assistance to Saskatchewan to develop a tourism and recreation plan for the southwestern area of Saskatchewan.

INTERIM MANAGEMENT OF LANDS (SECTION 12)

No schedule is provided as to when Canada would expect to acquire the full 350 square miles (906.4 Km^2) of land for the park. Saskatchewan agrees "...to manage the proposed national park in a manner that recognizes the need to maintain the lands in their existing natural state for park purposes prior to the transfer of administration and control of such lands to Canada." (Section 12.1, subject to escape clause). In addition, until lands are transferred to Canada, Saskatchewan will enact regulations that ensure wildlife management on proposed park lands that is consistent with National Park policies and objectives (Section 12.2).

EXPROPRIATION (SECTION 13)

Both Canada and Saskatchewan agree that no land will be expropriated for purposes of the national park.

GRASSLANDS NATIONAL PARK - A VISION FOR THE FUTURE

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INTRODUCTION

The signing of the Canada-Saskatchewan 1988 agreement toward the creation of a grassland national park marks the beginning of a new phase in the conservation of prairie lands. This new phase requires a regional, integrative approach to management in a phased, step-by-step manner for two reasons. First, it is clear from the agreement that it will take many years to establish the full park area. Second, while Grasslands National Park is a significant contribution to the system of conservation lands in Canada and a focus for conservation in southern Saskatchewan, it is only one part of an overall larger conservation regime needed for prairie lands. The park will, at its maximum, comprise only 350 square miles (906.4 km^2) of prairie landscape separated into two segments with artificial boundaries. This park will be two small islands; it will not be ecologically viable and its protection will require careful management of adjacent lands. The park must be integrated into the larger system of conservation lands in southern Saskatchewan to ensure its survival.

All levels of government must work more closely with public interest groups to ensure the success of our common objectives. The success of this approach has been shown with Grasslands National Park. We view the cooperative spirit for this park demonstrated by Canada and Saskatchewan as an opportunity to develop an integrated conservation management program for southern Saskatchewan dedicated to the protection of the grasslands region. We envisage an integrated system of conservation lands consisting of Grasslands National Park, provincial and regional parks, ecological reserves, historic sites, heritage trails, and wildlife reserves. This view of a larger conservation region follows from the Canadian Heritage Lands concept advanced by the federal minister's Task Force on Park Establishment. In this regional vision, all parties with mandates for recreation and land protection must be involved, including the tourist industry and municipalities. Management units already exist that could form part of this larger heritage plan, for example, Cypress Hills Provincial Park, Fort Walsh National Historic Site, and the Prairie Wildlife Centre. Initiatives have already begun to integrate similar mandates of different management agencies in the interprovincial parks concept currently being explored by Saskatchewan and Alberta. That approach, if accepted by Alberta and Saskatchewan, will accommodate the different administrative and regulatory processes between the two provinces to achieve common resource management objectives for a region. In its "Prairie Conservation Action Plan, 1989-94," World Wildlife Fund Canada further outlines numerous cooperative actions which governments and other groups could take to protect prairie environments.

To achieve this common vision, we must all adopt a planned, step-by-step approach. Such a phased approach is necessarily long-term and requires cooperative action among all parties. In Section 9 of the 1988 agreement, Canada and Saskatchewan agree to establish a consultative committee of federal and provincial officials. We support that initiative but regard it as incomplete and we stress the need for continued, shared involvement of interested parties. Continuing involvement of organizations such as the Canadian Parks Service, Saskatchewan Parks, Recreation and Culture, Saskatchewan Environment, rural municipalities, representatives from the conservation group coalition, farmers, ranchers, and oil and gas interests is critical.

The consultative committee should be expanded to include representatives from these groups to (1) examine and evaluate the concept of a system of heritage conservation lands for southwestern Saskatchewan and (2) define the structure and role of an advisory committee for management of the park and those heritage lands. A management structure should provide for partnership and public participation in at least the following areas: (1) development of a management plan for Grasslands National Park and a regional heritage lands system, (2) development of environmental protection criteria for oil and gas exploration in the proposed park areas, (3) the identification of lands of natural significance worthy of being protected within a regional heritage conservation system, (4) the mechanism for land acquisition within the proposed park area and acquisition of lands outside the park that would be part of a heritage lands system (An example was discussed in a proposal submitted to the Canadian Parks Service by the Canadian Nature Federation and the Nature Conservancy of Canada.), (5) participation in interim management of park lands, and (6) identification of studies needed to document natural, archaeological, and cultural aspects of the region.

We believe it is incumbent on all parties involved in discussions over Grasslands National Park to articulate their vision for the park. We have provided one viewpoint. It is also important for all parties to identify the specific management issues, both immediate and long-term, that face the park. Four of these issues are addressed in the following four sections.

INTERIM MANAGEMENT CONCERNS

What are some of the immediate management concerns that the Canadian Parks Service will have to deal with in establishing, developing, and planning Grasslands National Park? There is an immediate need for an effective warden service in the Grasslands Park area. In the summer of 1987, 40 rattlesnakes were shot at a hibernaculum in the park. Two years earlier, it was suspected that a Golden Eagle (*Aquila chrysaetos*) nest was destroyed; documentation was not conclusive. Hunting pressures over the next few years are likely to be higher than normal in the park area. For these and other reasons, it is imperative that the warden service should be established immediately.

The Canadian Parks Service must continue to be sensitive to local concerns. To say that there is much local frustration about the establishment of this park in the Val Marie/Killdeer area and that the frustration needs to be dealt with effectively is an understatement. For example, there are local concerns regarding the erosion of the tax base on which the Municipality of Val Marie will operate. Land owners and leaseholders are concerned about the terms of specific compensation for their parcels of land; they view the terms of the 1988 agreement related to compensation as too vague. Local residents are concerned about future fire management policy, particularly around the periphery of the park. The local fire departments lack sufficient funding and manpower for large fire control. In addition, hunting regulations need to be clearly defined for the area around the park and appropriate management techniques developed to control the impact of wildlife damage on farm and ranching operations.

There is a great need for a Public Management Committee to be formed that can work in partnership with the Provincial Parks Branch and the Canadian Parks Service. There are a number of immediate management concerns to which a joint management committee could make significant contributions. For example, it is necessary to once again examine the possibility of free-ranging bison in the area. It has generally been concluded that this was not possible but new management techniques suggest that the possibility should be re-examined. A number of ranchers in the area have small herds of bison on their land. It appears that, if young bison are raised with cattle and movement patterns are established from this association, bison can exist in an area with no extraordinary means of fencing or management requirements. The question of bison in the Grasslands National Park needs re-examination. A joint management committee could also be extremely useful in assessing the adequacy of the oil and gas exploration guidelines. Certainly a part of this is to evaluate the adequacy of the guidelines that were used in the 1982 seismic operations. The management committee could also be very useful in advising on the extent that the core areas should be grazed by domestic cattle.

THE ECOLOGICAL STATUS OF GRASSLANDS NATIONAL PARK

What is the ecological status of the land that is being formed into Grasslands National Park? This is a very difficult question to answer. There are no benchmark areas of northern mixed grass prairies that have been set aside and not grazed by domestic cattle. We have very little information that describes the prairies of 150 or 200 years ago. Robert Copeland's studies in the 1950's and 1960's of ungrazed prairie land are of value in this regard but they have their limitations. For example, Dr. Copeland studied only upland areas and dealt only with the plants that were present. There are many important ecological questions that are very difficult to answer. For example, what was the organic content of the original prairie soil in the mixed-grass prairies? Can we compare it to our current knowledge of croplands for which we know that 50% of the organic content of the soil has been lost? What about the other habitat types such as valley bottoms and the riparian communities like? We know virtually nothing about the original prairie and how it has been affected by years of grazing by domestic cattle. What was the extent of terracing or soil compaction or the trampling of bottom lands as it occurred on the original prairies? How has the water quality of creeks and rivers changed during this past century? Some of these questions can be partly answered. The 1986 study by Don Blood and George Ledingham conducted on the 142 Km^2 of land already owned by the Canadian Parks Service is a good beginning. They found, using Copeland's studies as a baseline, that the upland areas in the Frenchman River Valley were most likely a Stipa-Bouteluma-Agropyron dry prairie, much as it is today. Grazing has changed the percent frequency of these plants but there has not been a major change in the upland grassland species. On the other hand, they found that the valley bottom areas, the tributary areas and the sage greasewood shrublands have been seriously altered by grazing. Perhaps the riparian sites are in worst condition of all, especially those along the Frenchman River. In-depth testing of the hypotheses set out in the report by Blood and Ledingham is necessary. If further testing supports these hypotheses, then the need for restorative management programs is indicated.

Innovative research methods will be required and a management committee that can access some of the best scientific advisors in North America to address these questions would be immensely valuable. There are protected grassland reserves in the United States such as the Lostwood National Wildlife Refuge. A scientific advisory committee for Grasslands National Park could investigate the management techniques of currently protected grasslands and their applicability to the park. Dr. George Scotter has listed a number of important scientific research topics for grassland areas: studies of range conditions and trends, non-chemical methods of biological control, studies of the efficacy of rest-rotation grazing, the application of prescribed burning, research on the complimentary relationship between domestic grazers and wildlife and research into a spatial diversity of grazing pressures to accommodate fauna adapted to different levels of grazing. He calls for the establishment of a native grasslands research station and a cooperative network of researchers. There are many other important research and management needs that a scientific advisory committee could help to articulate.

PARK INTERPRETATION

What type of experience will visitors have when they come to Grasslands National Park? The type of experience that most visitors would be most impressed and inspired by is fairly clear. Grasslands National Park could offer visitors the experience of the vastness of a wild prairie landscape; people could stand on ridges in the park or in the centre of the Frenchman River Valley and experience the sweep and scale of that vast landscape, uninterrupted by fencelines without a road or building intruding into view. This would leave a deep and unforgettable impression on the visitor.

From an experiential point of view, this is a very fragile landscape. One park road or building carelessly located can greatly detract from the type of experience that the visitor has within Grasslands National Park. A building in this land can easily be seen for 20 or 30 miles. By carefully designing the park from the visitors' point of view (i.e. the careful placement of roads outside the park and the careful location of campgrounds and other necessary facilities behind hills or inside valleys), the wild natural character of this landscape can be maintained. If the park is not carefully planned to meet the anticipation of visitors, then the 900 Km^2 will seem woefully small. If it is carefully planned, this size may well meet this challenge. It will offer a unique experience of wild prairie landscape, an experience that is increasingly unavailable elsewhere in western Canada.

The park can be experienced and interpreted on many different levels. Perhaps the hardest level to preserve is the vast sweep of a near-natural prairie landscape. If the park can succeed at this level, then the many other levels of experiencing and enjoying the park will be successful.

THE REGIONAL CONTEXT OF THE PARK

What is the relationship between the Park and the region? There are two important reasons why the park must be conceived in its regional context. The first reason concerns the size and ecological integrity of the proposed park. We indicated earlier that the park will consist of two separated segments, each defined by artificial, not ecological, boundaries. These two small islands will not be ecologically viable and will require buffer zones on adjacent lands that will need to be carefully managed. Earlier in this paper, we presented a regional vision for the park area, the concept of an integrated system of conservation lands for the area consisting of the Grasslands National Park, provincial and regional parks, ecological reserves, historic sites, heritage trails and wildlife reserves. The need for a buffer system around the park is added reason to think in a regional context.

The second reason why the park must be considered in a regional context is because of the unusual concentration of heritage resources, historical and biological, found in this area of southwest Saskatchewan. If these resources were integrated and marketed under one rubric as the Palliser Triangle Heritage Region, such an approach would lead to the greater enjoyment and more effective preservation of those heritage resources. In addition, it would provide a strong foundation for the development of an important tourist region for southwest Saskatchewan.

What are some of these heritage resources? One could begin to enjoy the region by learning about the Palliser Expedition and how the driest region of the Canadian prairies has come to be known as the Palliser Triangle. There is also the history of the Commission that surveyed and set the International Boundary and the many interesting stories and anecdotes that surrounded that effort. The Cypress Hills is an area very rich in heritage resources, the geological formation of the hills, the very interesting plant communities that exist on the Cypress Hill uplands and the extraordinary wildlife populations that originally existed in the Cypress Hills area. From the point of view of human history, one could learn about the Cypress Hills massacre and its role in establishing Fort Walsh and the part that the establishment of the fort played in the development of the Northwest Mounted Police. This theme could be traced to the presence of the R.C.M.P. Training Academy in Regina today. One could learn about the history of Sitting Bull in Canada through a visit to the Wood Mountain Post Provincial Historic Park. There is the history of the Metis settlers of southwest Saskatchewan and the story of how they left the Red River district after the first Riel Rebellion and settled in this part of Saskatchewan. That theme can be traced through to the very important French presence in this area today. We could trace some very interesting regional histories of towns such as Willowbunch and the story of the Willowbunch giant or trace the blizzards of the winter of 1906/1907 and the impact it had on the large, open ranches. Certainly part of the heritage of the region is the existence of the book "Wolf Willow" by Wallace Stegner, an eloquent and personal interpretation of the history of this region. We could also trace the history of conservation in this area of the prairies. For example, we could trace the wildlife populations that were decimated in the late 1800's and early 1900's and efforts such as the three antelope national parks that existed for a short time. If we enlarged the boundaries of this region a bit, we could talk about Last Mountain Lake, the first bird sanctuary created on the North American continent. We could focus on the 32-year history of efforts to establish Grasslands National Park. Finally, if such a heritage region were contemplated, there would be need for an interpretive-orientation centre. The Prairie Wildlife Interpretive Centre, located on the Trans-Canada Highway at Webb, Saskatchewan, is a perfect facility to give such an overview and could serve as an information centre for the area.

In summary, there is an unusual concentration of unique heritage resources in this region of Saskatchewan. An unusual effort is required to preserve and interpret its natural and historical resources. If this effort was made, we would not only have a very successful Grasslands National Park but a new and successful interpretation of the heritage of the Canadian prairies.

REFLECTIONS ON THE HISTORY OF THE PROPOSED GRASSLANDS NATIONAL PARK

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Over 150 years ago, there was a dream that part of the great grasslands area of North America would be conserved. It was the dream of George Carlin who travelled throughout the prairies from 1832 through 1839. Carlin did not witness the destruction of the great bison herds which were largely exterminated from the North American prairies by 1900. The Canadian government, which had control of pastures at that time, established three or more grassland reserves with the specific purpose of preserving the remaining bison. When control of renewable resources was transferred to the provinces in the 1930's, those reserves were broken up and disbanded.

I want to talk a little about my own background because I have been accused many times of being the person who reinitiated the idea of a grasslands park. I clearly remember the native grasslands from when I was in school and living near Moose Jaw. All of the roadsides and fence roads were native. I have always been interested in nature. I recall one morning in spring on the way to school when, for the first time, I saw five or six bluebirds on migration. I never saw such beautiful color in my life. I also remember how each spring my father and several neighbors took excess horses and cattle out of the reserve and I would get to ride them on the range. That was the thrill of the year, maybe even more of a thrill than Christmas. In 1945, I came to Regina to teach at Regina College. Later I was appointed to the museum staff and I immediately joined the Natural History Society. I joined the Blue Jay Club at the Yorkton Natural History Society in 1942; there I found people with a common interest in nature. I am not the only one to blame for proposing a grasslands park in southern Saskatchewan; many other naturalists were involved.

In 1957, the head of the Canadian Wildlife Service in Ottawa spoke to the Natural History Society; this talk referred to the objective of national parks in saving significant amounts of each important ecosystem in Canada. When asked why there was no grasslands park, he said that there should be one and that we should get busy and promote the idea. Government officials were the ones who were supposed to know the country and where there might be a suitable grasslands area and yet we were supposed to get the job done. And so we talked for 6 years in the Natural History Society. We did not like the idea of a grassland park with trees, boating and swimming facilities, golf courses and all of the other things they put in national parks. We contacted the Saskatchewan government with a request for a reserve, a significant 100, 200 or 300 square miles of grassland. There was lots of crown land and some of it was very marginal for farming. Some of that land could be designated to become a grassland park, users of the land could then be informed of this plan and, from then on, leases would not be renewed as they expired.

There is a lot of fertility in our prairie soil; it is dry and there tends to be an accumulation of dry grass, causing some people to worry about fires. However, we wanted an area where we could observe undisturbed natural processes; we wanted a benchmark area where all grasses could grow in natural competition. We got nowhere with the provincial government; they were not starting to plan for ecological reserves then.

In 1963, the Natural History Society passed a resolution in support of a national park. After about 12 years, we seemed to reach a dead end. After a time, we had a NDP Saskatchewan Government; negotiations began again and by 1976, we had hearings on the proposed park. I gave a talk for the Natural History Society at Val Marie and the people were very receptive. The conclusion of the public hearings was presented in a report to the governments; the majority of the people in the Val Marie area and in Saskatchewan generally were in support of a park. Nothing happened again. Thirteen years later we still have no grassland park but, with the efforts that people are making now, there may someday be a park. Natural history societies are still optimistic and will support the Parks Service, providing that they remove cattle grazing and they do not turn the park into a dude ranch. We want a natural ecosystem. The ranchers will continue to operate around the park and we hope there will be a buffer zone to prevent overgrazing close to the park.

The environment now after 160 years of cattle grazing is very different. During these 160 years, we have abused our natural resources and exploited our soils. We hope that with the park people can learn how soil is gradually built up and that Saskatchewan will have one area where soil quality is not getting poorer and poorer.

Since my retirement, I have been trying to learn the plants of southern Saskatchewan. I hope to have enough time for further trips into the grassland park area which I think is a fascinating country.

VIEWS OF LOCAL RESIDENTS ON THE PROPOSED GRASSLANDS NATIONAL PARK

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This paper describes some of the concerns of the people in the area of the proposed Grasslands National Park. I live in the area and have been involved with the issue of the park since it began. Some concerns of people in the immediate area are about when or if the park becomes a reality and how it would affect them.

One concern is that of wildlife, particularly white-tailed deer, and the problems created by the no hunting policy in national parks. Any increase in the deer population is a problem, particularly in the wintertime, because the deer feed on ranchers' haystacks. Sixty deer are grazing on one of my haystacks and they are absolutely destroying it. Two things you can do when there are too many deer are to either shoot them or feed them and I do not believe in feeding them. This country does not need more welfare costs. Deer have looked after themselves all through history. A costly alternative is to fence deer out of the feed yards but that is a cost that the ranchers should not have to shoulder.

Another concern is that, when the Parks Service acquires the land, the grass will grow tall creating a big fire hazard. After a few wet years, the grass gets really tall and the danger of fire, which can move very fast in tall grass, will be high. Local fire departments are not equipped to handle such fires. If there is a fire now, there are lots of local volunteers who come with the water trucks to help out. The more land that the Parks Service buys, the fewer people there will be to help put out fires. Without cattle grazing in the park to control the grass, there will be a real problem. I have talked to a few grazing experts and opinions vary. Most of the local people want controlled cattle grazing to keep the grass at an acceptable level.

Many of the experts think that ranchers just exploit the area. Initially the park it was to include the P.F.R.A. pastures near Val Marie because the community pastures, already owned by government, could easily be designated as a park. Ranchers and other people living there would not be disturbed. However, these pastures were overgrazed and were in a condition not nearly as good as those maintained by the ranchers. That indicates how well the ranchers were looking after their land. If cattle grazing is correctly managed, it does not have to hurt the land. Grasslands evolved with grazing by bison and deer; eliminating grazing will not be good for the grasslands. We are going to have to look at cattle grazing as an option.

Another concern is compensation for land. The Parks Service offers a complicated and vague compensation formula when landowners want to know what they can expect to be paid for their land if they want to sell. All we want to see is a dollar figure.

Many people have had input into this grassland park and yet when you talk to them they say they have never been there. There has been a lot of input from people who do not understand the issues. So many of these people say that the park would be a nice thing but they are expecting lakes and trees.

I have summarized the major concerns of the people in the area and I hope you will try to understand those concerns.

THE PRAIRIE MIGRATORY BIRD SITE INVENTORY

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INTRODUCTION

Under its mandate (Migratory Birds Convention Act 1917, Canada Wildlife Act 1973), the Canadian Wildlife Service (CWS) is developing national strategies for the protection and management of migratory birds and their habitats. In order to set national and regional goals for habitat protection, CWS requires an inventory and classification of important migratory bird sites according to historic use, function and current status. These sites are ranked using selective criteria for designating sites of international/national, regional and local significance. The migratory bird habitat inventory thus contributes to national long term goals: (1) to acquire and manage critical migratory bird habitats under extreme threat, (2) to identify and rate important wetlands in several regions and negotiate for protection and (3) to identify appropriate sites for designation of wetlands of international importance under the Ramsar Convention (Canadian Wildlife Service 1984). CWS, in cooperation with provincial and non-government wildlife agencies, plans to establish an expanding network of protected key wildlife areas distributed throughout the natural regions of Canada.

In prairie Canada, CWS has developed a regional approach and methodology for the inventory and classification of migratory bird sites. Using a map overlay system, CWS has assembled information on landscape units, historic migratory bird distribution patterns and functional status of sites and has related these to broad ecological management zones. Sites of regional significance are identified for featured species from population indices, seasonal use status and species rarity. The mapping survey, which also documents sites used by uncommon species, will assist resource planners and wildlife managers in ranking habitats for protection, predicting disturbances to bird populations and monitoring migratory bird responses to land use changes.

ECOLOGICAL MANAGEMENT ZONES

Cues to avian habitat selection are based upon spatial and structural interaction of the surrounding landscape with associated vegetation cover (Hilden 1965) and with climatic and landform factors (Balda 1975, Kantrud and Kologiski 1983). Individual species may respond to environmental stimuli at a site level but, at a macrohabitat scale, assemblages of species and dispersion of sites may be linked to spatial landscape units. Using ecological land classification guidelines (Environmental Conservation Task Force 1981), CWS standardized a land classification system for the prairie provinces by assembling and mapping two levels of landscape units: the ecoregion and habitat subregion (Pedocan 1983). These ecological land units provide an effective framework for integrating spatial and contextual environmental data with migratory bird use and function data. Differing hierarchical levels of mapping use satisfy national and regional planning needs and collate regional and local information on migratory bird habitat requisites for differing levels of species use and function.

The framework of relatively small habitat subregions nested within the broader ecoregions permits stratification for sampling, monitoring and organizing migratory bird and habitat data according to ecological criteria. The ecoregions as defined by assemblages of regional landforms characterized by climatic gradients expressed by vegetation, soils, water and fauna (Environmental Conservation Task Force 1981) provide a regional ecological perspective on factors which influence avian species diversity and abundance. Similarly the habitat subregion defined by relief, surface form, drainage and broad genetic materials (Pedocan 1983) furnishes the landscape framework for integrating broad physical habitat requirements for populations of breeding and staging birds. Examples of ecoregions include the aspen parkland and mid-boreal mixed wood; examples of habitat subregions include the Allan Hills hummocky moraine and the Regina plain.

MIGRATORY BIRD SITE MAPPING

CWS prepared migratory bird site maps at a scale of 1:250,000 for the prairie provinces. Contractors plotted site location data and referenced information on historic bird numbers by species, season of use and life cycle function. Information was drawn from various sources such as breeding bird atlases, prairie nest records, breeding bird census data, waterfowl surveys, biologists' reports and naturalists' records. The quality and quantity of data varied from site to site due to lack of standardized survey methods. Although current information was preferred, most migratory bird site data were qualitative and dated (1965-1986). CWS assigned relative confidence levels to the documentary data to compensate for differences in chronology and levels of precision.

Migratory bird sites, which fulfil a life cycle or seasonal function such as breeding, foraging or staging for featured species, are defined as core areas delineated by concentrations of individuals, by the presence of regionally rare species or by high species diversity. Sites include nest sites of uncommon species, colonial nest locations and staging and moulting areas. Sites designated for uncommon species use were defined according to criteria such as rarity (Bryant 1983), endemic or limited distribution, relative dominance and habitat specialists that are representative of threatened ecosystems (Adamus and Clough 1978). Lakes and wetlands constitute most of the mapped sites although locations of threatened raptor nest sites are numerous in some regions. Other upland breeding areas for most species groups are poorly defined due to lack of information on passerine species and to the relatively wide dispersion of breeding pairs over large areas. Plotted migratory bird sites were enumerated and coded to depict featured species or species groups such as dabbling ducks and to indicate reliability of data. The maps are cross-referenced to documentary data on species counts, flock sizes, frequency of use, nest observations and reference sources.

RATING SITE IMPORTANCE

Due to the variability of survey data, CWS selected several criteria to designate important sites such as population attributes relating to size, species richness and species rarity (Fuller 1980). Where population census data were available, limits on flock size or numbers of nesting pairs were set individually for different species groups or featured species. A criterion based upon concentrations of birds attaining 1% or more of the regional or national population of a species (Carp 1977, Lloyd 1984, McCormick et al. 1984) has application limited to species whose populations are intensively surveyed. Furthermore, adoption of this criterion would eliminate many important waterfowl concentration areas. Instead, CWS designated important waterfowl staging areas which supported seasonal peaks of more than 2000 ducks (Anas spp.) and 1000 geese (Anser spp.). Important colonial nesting sites were identified by counts of more than 20 active nests for waders and 100 active nests for sea birds. Species richness criteria were difficult to apply in most cases; well-documented sites represented by 80 species or 25% of species resident or migrant in Saskatchewan were considered important sites. Site importance was also designated by one or more records of endangered species using the site or by three or more nest locations, within a 3 Km radius, occupied by rare or threatened species. Other sites were rated important despite the lack of supporting data if reliable sources indicated that the sites were significant to species for breeding, moulting or staging.

The migratory bird site mapping program involved 4 years of effort resulting in the production of 118 maps depicting more than 5000 documented uncommon species sites and approximately 1500 important sites. This data base has been computerized and updated to allow rapid retrieval of records. Currently a priorities document is under preparation which will screen site information according to rigid species criteria and rank the important sites according to international/national, regional and local significance (Ealey 1989).

ACKNOWLEDGMENTS

The author thanks C. Adam, D. Ealey and S. Nickels who compiled and mapped most of the documentary site data. Al Smith provided data and much assistance to the project. Numerous other biologists and naturalists furnished migratory bird site records.

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THE ROLE OF ECOLOGICAL RESERVES IN A SYSTEM OF SMALL NATURE RESERVES IN SOUTHERN SASKATCHEWAN

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The objectives of this paper are (1) to outline the rationale for developing a system of small nature reserves on the Saskatchewan prairies and parklands, (2) to identify the role of ecological reserves as part of a system of small nature reserves in preserving rare and endangered prairie and parkland species and (3) to recommend site selection and management guidelines and procedures for establishing and maintaining a system of small prairie and parkland nature reserves.

There are many ways to establish small nature reserves. Protection levels can range from ecological reserves with total legal protection to arrangements between landowners and private interest groups not to use or not to develop specific sites. Parks where some uses are allowed (usually limited to recreation and associated activities), fall between these two extremes.

Why have a system of small nature reserves on the prairies and parklands? Would a system of large reserves be better? Our knowledge of prairie and parkland ecosystems and the extent of their anthropogenic modifications permits at least partial answers to these questions.

The following four purposes for the preservation of natural areas have been widely recognized: (1) maintenance of genetic diversity, (2) research, (3) education and (4) nature appreciation (Taschereau 1985). In addition, genetic diversity is best maintained via protection of ecosystem processes; the integrity of these processes is best maintained via the preservation of landscape units (Rowe 1988, Epp 1988).

From a conservation viewpoint, clearly the ideal system of nature reserves is to maintain large, physically connected natural areas ensuring preservation of ecosystem processes and thereby protection of the maximum number of rare and endangered species. On the Canadian prairies and parklands, however, such a system is no longer possible. In fact, these are among the most anthropogenically-modified ecosystems and landscapes anywhere. Furthermore, the remaining natural areas continue to disappear rapidly (Rowe and Coupland 1984, Rowe 1987, Coupland 1987).

Clearly, the Canadian prairie and parkland ecosystems are already severely fragmented. Many conservationists believe that in fragmented ecosystems, a number of small, scattered nature reserves will preserve more species than will a few large reserves (Margules and Usher 1981, Jarvinen 1982, Simberloff 1982). There is no evidence, however, that this holds true for large, relatively undisturbed ecosystems (Margules et al. 1982). Certainly, the reserves must be large enough to maintain the original species composition to the maximum degree possible as well as to maximize species richness (Jarvinen 1982, Helliwell 1983). On the Canadian prairies and parklands, the choice is limited to a few large reserves and many small ones. In fact, the major urgency is quite simply to preserve whatever possible with priority given to those sites which contain the maximum number of species (Epp 1986).

From a practical as well as an ecological viewpoint, a mix of small and large reserves is preferable to a system of small reserves only or a few large reserves. This ensures maintenance of ecological diversity, a prerequisite to ecological stability (McNaughton 1985). Furthermore, long-term ecological stability ensures maintenance of ecological processes and genetic diversity, requirements for the maintenance of healthy populations in perpetuity, a prerequisite to preserving endangered species. Species-specific measures may be required initially in the case of species with dangerously low populations, such as the Whooping Crane, but early attention to ecosystem process preservation should limit the need for such special measures. It is important to note that the negative influence of unpredictable environmental fluctuation on a species increases as a population decreases, exacerbating trends (May 1986).

Special means to protect very low populations include species-specific legislation and maintenance of adequate habitat in appropriate condition. The habitat must be sufficient to maintain at least a minimum population size for continued genetic viability (Shaffer 1981). In order to attain this goal in perpetuity, the population must be kept above the minimum required for maintaining genetic viability of the species as there always exists a potential for population crashes caused by diseases or other unpredictable occurrences. In order to determine such threshold levels, research is an absolute requirement. Nonetheless, before detailed data are available, it is best to err on the side of caution.

As mentioned previously, ecological reserves are on the protection end of the protection/non-protection spectrum. In Saskatchewan, an ecological reserve is "any Crown land designated under clause 4(1)(a) which sustains or is associated with unique or representative parts of the natural environment" (The Ecological Reserves Act 1980). Maximum protection also is the major thrust of ecological reserves legislation in Manitoba and Alberta.

The primary goal for creating ecological reserves in Canada is preservation of natural areas (Taschereau 1985). More specific objectives in addition to this general goal are recognized as follows (Epp 1986): (1) gene pool preservation to maintain genetic variety for the future, (2) creation of pristine environmental bench marks to guage human influences on the environment, (3) preservation of representative ecosystem samples to maintain ecological processes, (4) preservation of special and unique environments which are part of our natural heritage and which have educational, research and cultural value, (5) preservation of environmentally sensitive areas with little resilience to ecosystem disturbances, (6) preservation of core parts of ecosystems which contribute significantly to ecosystem and ecological process stability, (7) preservation of examples of ecosystems which have been severely disturbed by human activities so as to be able to guage ecosystem recovery and develop an understanding of the processes responsible for ecosystem recovery, (8) maintenance of ecological diversity as a prerequisite to maintenance of ecosystem resilience, stability and genetic diversity, (9) preservation of refuges and breeding areas for rare and endangered species so as to limit anthropogenically-caused extinctions, (10) maintenance of ecosystem processes and (11) maintenance of extant landscape units (including waterbodies) as a prerequisite to maintaining ecological processes. To meet these objectives, legislation, development and management programs and an improved data base are necessary. Legislation has been established but continued development of programs is needed and improving the data base is an ongoing requirement as research advances and identifies new needs.

Site selection, part of the development process, is one of the most important early exercises in establishing any nature reserve system as it is here where location and size of reserves is chosen. Epp and Elsaesser (1986) have recommended the following site selection criteria or conditions which should influence site selection in Saskatchewan. These criteria are based on wide ranging discussions with the conservation and ecological community: (1) potential loss of natural values, (2) a reasonable distribution across the province, (3) representation of all ecoregions and ecodistricts, as defined by Harris et al. (1983), and common species therein (True representativeness, however, must include the extremes of the ecological spectrum (Smith and Theberge 1986).), (4) presence of a high level of sensitivity to disturbance, (5) presence of an unusually high level of ecological diversity, (6) presence of unique ecological characteristics and (7) presence of encumbrances which are inconsistent with ecological reserve goals.

Management of ecological reserves must be in line with the intent of the legislation. Management also should be designed so that the maximum number of objectives can be met. Details, however, should be site-specific due to geographic variation. For example, grazing by domestic livestock may be a useful management strategy in some reserves but harmful or just not feasible in others.

Beyond criteria for selection and management of individual ecological reserves is consideration of criteria needed to establish an optimum system of reserves. This is an important concept in any jurisdiction which is just beginning to establish ecological reserves. Any system of such reserves should cover all of the criteria discussed above but also should be designed to coincide with key ecosystem species distributions (Rapoport et al. 1986).

In conclusion, the objectives and selection criteria for creating an ecological reserves system in the prairie and parkland now are widely recognized. Implementation is only in the initial stages. The challenge now is to tie the preservation of natural areas to forthcoming conservation strategies recommended by the National Task Force on Environment and Economy (1987). Furthermore, a wider approach is needed if rare and endangered species populations are to be maintained in perpetuity as they require more habitat than possibly can be preserved by any legislatively based ecological reserves system on the Canadian prairie and parkland. Cooperation with private landowners to a common end is required for which much of the onus falls on conservation groups to provide the appropriate liaison base.

The opinions expressed in this paper are those of the author and do not necessarily reflect those of the Government of Saskatchewan.

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ECOLOGICAL PROCESS MANAGEMENT FOR MAINTAINING BIOLOGICAL DIVERSITY ON THE CANADIAN PRAIRIES

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The purpose of this paper is to discuss and recommend habitat management requirements for maintaining biological diversity and to assist in curtailing the extinction of native prairie and parkland species in western Canada. The recommendations are predicated on the assumption that extinctions caused or exacerbated by human actions are undesirable from ecological and/or human self-interest viewpoints. Biological diversity is defined as "the variety of species in ecosystems as well as the genetic variety within each species" (The Conservation Foundation 1987).

Why is biological diversity important in preventing extinction? "Extinction is fundamentally a demographic process, influenced by genetic and environmental factors" (Lande 1988). Once such a loss has occurred to the point of homozygosity, habitat protection may not be enough to save a population. This is caused by lack of control over stochastically determined environmental changes caused by a fundamentally unpredictable climatic system (Bryson 1988).

Some extinction processes are an entirely natural part of life's adjustment to complex non-linear, non-equilibrium relationships among climate, soil and water systems. Furthermore, the human influence was also entirely natural as long as human populations remained entirely dependent upon surrounding plants and animals for survival without conscious ecosystem manipulation. However, this is no longer the case and, at the present time, no part of the world is immune to the deleterious effects of our human technology and massive population.

Natural extinction in the past has occurred stochastically or unpredictably as species evolved into new species or died out (Lande 1988). More spectacularly, species have died out during mass extinction events (Jablonski 1986). As many as eight major such events have been identified in the palaeontological record (Raup and Sepkoski 1986). The two most generally known are the late Cretaceous dinosaur die-off and the late Pleistocene mammalian megafaunal extinctions. Other than the present mass extinction, the only former such event attributed at least partially to anthropogenic forces is the late Pleistocene mass extinction of large mammals in North America and Eurasia; this overkill hypothesis remains controversial (Martin 1984, Graham and Lundelius 1984).

Given the fact that humans are the major cause of the present mass extinction event, why should people be concerned with this? After all, it is our technology which is enabling our large population to survive.

A consequence of extinction always is the loss of genetic diversity. Although there is some research to the contrary (Goodman 1975), it is commonly acknowledged that genetic diversity causes ecosystem diversity and this is directly linked to short-term functional stability of ecosystems (van Voris et al. 1980, King and Pimm 1983, McNaughton 1985). However, ecosystems are non-linear in their internal and external relationships and, hence, exhibit a high level of sensitivity to initial conditions, with populations decreasing in an "accelerating spiral" once the process is started (Norton 1987). As a result, adjacent system "trajectories on average separate exponentially" (Schaffer and Kot 1986). "Hence, even small, and certainly major perturbations to a system can result in a loss of certainty or predictability" (Epp 1988b). In fact, empirical research has shown that "species are not interchangeable" in the long-term so that instability can be incurred by an extinction even in a very diverse ecosystem (McNaughton 1985).

Ecosystem diversity is more than species richness and genetic and geographic variability. A strong ecosystem hierarchy is required to maintain population and species stability in the face of "aperiodic or chaotic" external environmental influences (Dony and Denholm 1985, Takeuchi and Adachi 1986).

Aside from the known and unknown dangers of ecosystem collapse, resource and economic potential are lost with reduced variability. For example, Suzuki (1988) points out that of the approximately 75,000 varieties of edible plants in the world, only about 20 are used for commercial production. Furthermore, the conclusion that a healthy economy is directly dependent on a healthy environment is becoming recognized by the business world and by politicians alike (National Task Force on Environment and Economy 1987). The Task Force report quotes David Buzzelli, Chairman and President of Dow Chemical Canada Inc. as saying: "Environmental and economic concerns must go hand in hand." It also cites the Honourable Tom McMillan, Canada's Minister of the Environment in 1987 as stating that: "It is not possible to have a sound economy without a healthy environment." Furthermore, the report recommends that each "province and territory should have a conservation strategy in place by 1992." If ever there was an opportunity in Canada to develop jurisdictionally and multi-sector, coordinated, ecologically-sound environmental management guidelines, it is now.

Given that natural diversity is essential for major ecosystem functions and survival, that humans are physically and economically dependent upon healthy ecosystems and that administratively our country seems ready for major new environmental protection initiatives, how may our lands and waters be managed best to maintain biological diversity? First of all, it is important to categorize our ecosystems from the point of view of the level and nature of human influence. Second, it is necessary to identify the primary ecological processes which are responsible for biological diversity within each of these ecosystem types. Third, it is necessary to identify the requirements for maintaining these processes and, hence, diversity. Last, it is important to outline management guidelines which, if implemented, will maintain ecological processes and preserve diversity.

Ecosystems may be organized into five major types based on the level and nature of human influence. These are (1) urban environments, (2) agricultural environments, (3) natural environments used primarily for resource extraction, (4) natural environments used primarily for recreation and (5) wilderness or near wilderness areas where use is limited to traditional subsistence pursuits.

Within prairie and parkland urban environments, ecological processes clearly are severely curtailed or disturbed. Primarily productivity by plants is limited to lawns, gardens and trees, all of which are tended artificially for special purposes or human uses. Some insects, birds, rodents and a few other small animals do manage to survive in these environments but usually in limited numbers and not as part of a complex ecological food web. Species are those which function best in youthful stages of ecological succession.

Agricultural ecosystems also tend to be youthful. This is necessary because youthful successional stages are biologically more productive than advanced stages and productivity is a major goal (Goldsmith 1985, Geerling et al. 1986). "The hard ecological fact is that we can increase ecosystem productivity but this results inevitably in less ecosystem stability and lesser stability leads inevitably to a decline in productivity" (Epp 1988a). The perceived need to increase productivity of desired organic materials accelerates the trend to early successional monocultures, further reducing biological diversity from the original natural state. This process leads to a situation in which the need for increased productivity sows the seeds of its own demise as nutrients are removed from agricultural ecosystems and soils erode and otherwise deteriorate. This trend has resulted in a major resource management conundrum: increased ecosystem productivity and stability are required at the same time - an ecological impossibility given present agricultural practices (Epp 1988a).

Human activities which utilize natural environments for resource extraction on Canada's prairies and parklands are limited. They include, majoratively, livestock grazing, mining, fur harvesting, forest harvesting and lake and river fisheries. Except for mining, these activities do not destroy the landscape base (including waterscape) but they do affect population dynamics and ecological processes including succession. The tendency is toward maintenance of youthful successional stages in ecosystems and even monocultures, although not to the extent inherent in agricultural ecosystems.

Harvesting natural renewable resources in excess of sustainability levels has become a major and controversial issue in all of Canada as well as in the world in general (World Commission on Environment and Development 1987). Overgrazing of prairie grasslands has resulted in substantial "decrease in vigor of the mid grasses" (Coupland 1950). Heavy grazing causes "a shift in the composition of vegetative cover towards a more xeric type of community" (Coupland 1961). This process includes an increase in the percentage composition of short grasses and unpalatable forbs such as pasture sage. Furthermore, elimination of the major large natural grazer, bison, and control of prairie fires has resulted in "encroachment of woody vegetation on grassland" (Looman

1979). This situation has reduced grazing productivity and sustainability for grazing but has increased habitat for deer and other shrub-dependent animals. Moreover, elimination of most of the predators has exacerbated the trend to less biological variety. In macroscopic ecosystems where space is a limiting factor, the old ecological hypothesis that "the presence of predators in ecosystems maintains a diversity of prey species" (Lewin 1987) likely holds true.

The forestry profession in Canada is calling for ecologically-sound forest management and for extensive rather than intensive management to fulfil long-term economic goals with ecological benefits (Benson 1988). The forest industry recognizes the need for sustainable forest utilization but "in ecosystems that are modified to the extent necessary to ensure that society's expressed needs and values can be met in perpetuity" (Pollard 1987).

With regard to fisheries, pollution is a greater threat than over-fishing. Catch regulation is fairly stringent and efficient for both sport and commercial fishing but continued increases in industrial and domestic effluent, exacerbated by fertilizer and pesticide residue in runoff from agricultural lands, create artificially eutrophic aquatic ecosystems with species composition further affected by toxicants. Furthermore, increased flow regulation changes ecosystem dynamics.

Mining now cannot occur on a large scale without environmental assessments and reclamation is becoming the rule rather than the exception. Impacts on species extinction potential are studied but, over the short-term, reclaimed lands necessarily are in youthful successional stages, often covered with non-native vegetation.

Natural environments which are used primarily for recreation normally are protected as parks. Overuse is the most serious ecosystem problem, multiplied by developments designed to serve the recreational users. Here, fortunately, controls are relatively stringent and effective and the trend in parks is to limit the use of areas which have been zoned for maintenance of a natural state. In the national parks system, an "ecosystem approach to conservation of natural diversity is a foremost aim" (Muir 1985). Pressures to the contrary remain strong however.

Clearly, wilderness or near wilderness areas, where natural processes are not interfered with by human activities, are not in need of intensive management so as to maintain biological diversity. Normal, natural processes maintain a high level of diversity. Rather, the need is for developing a management system which will ensure that substantial wildernesses remain in that condition in perpetuity and for identification and ranking of sites which are needed for such protection. Unfortunately, the prairie wilderness in Canada is gone but substantial forest wilderness areas lie to the north.

Managing ecosystems and resources for biological diversity is ecological process management. Processes can be both functional or synchronic and time-dependent or diachronic. Functional processes include:

> "(1) biogeochemical cycles, especially the hydrological cycle, (2) primary and secondary production (i.e., energy flow), (3) mineralization of organic matter in the soils and sediments, (4) storage and transport of minerals and biomass and (5) regulation of the processes in (1) through (4), often by the activities of animals" (Ricklefs et al. 1984).

Time-dependent processes include ecological succession following disturbance (Odum 1969, Goldsmith 1985) and the ecosystem-climate adjustments (life history evolution) which take place over geological time (Guthrie 1984, Partridge and Harvey 1988). Bridging these two types of processes is energy movement in ecosystems. Energy transfer does not occur in the form of a steady state but functions "with alternate pulsing of production and consumption" (Odum 1988). Such a system reinforces energy use and is a self-organizing pattern for maximum long-range performance (Odum 1988). Clearly, these ecosystem processes fall within the purview of environmental management concerns.

A very important biological observation with strong management implications is: "Habitats are not independent of the species that evolve on them" (Partridge and Harvey 1988). Controlling a defined habitat are the landscapes (including waterscapes) and the climates which encompass or influence them. At the "moderately large scale" where management can play a major role, each landform is a "natural unit" (Rowe 1980). To manage landscape units as functioning wholes is to manage ecological process. "The manifest relatedness of all components within landscape ecosystems is a useful antidote to the narrow traditional thinking whose economic expression has been over-exploitation of the earth" (Rowe 1988).

Clearly, the landscape unit is where it all comes together, where biological diversity is dependent upon ecological processes and where ecological processes are in mutual interaction with the nature of the land, water and climate itself. Consequently, the most efficient and long-term effective way of managing habitat for biological diversity is to ensure maintenance of ecosystem processes via maintenance of landscape integrity.

Given the situational facts and ecological theories as outlined, what is the best way to manage our landscapes so as to preserve ecological processes and, in turn, protect biological diversity?

Following are some recommendations which should assist in attaining this goal.

(1) A system of natural areas representing all environmental types, including both typical and extreme forms, must be identified and protected.

(2) Natural ecosystem processes must be allowed to proceed unimpeded within all natural areas so as to maintain self-organizing patterns and long-term performance and stability; however, natural processes may need to be simulated where they are missing and reintroduction is not practicable, as in the case of uncontrolled burning, large herbivore grazing and the absence of large predators. Consequently, controlled grazing should assist in sound management of native prairie and parkland ecosystems with prescribed burning to control shrub growth as required to maintain the grasslands.

(3) The natural areas should be positioned such that natural gene flow among them is not prevented.

(4) The natural areas should be positioned so as to maintain the maximum amount of ecological variety given the lands and waters available. This variety needs to be more than species diversity; landscape diversity is essential to maintaining ecosystem variety. Maintaining overall ecosystem variety includes protecting substantial portions of the interiors of large ecosystems in addition to the edge areas where ecological variety per unit area is naturally high.

(5) Research is required to determine the optimal size and distribution of natural areas.

(6) A judicious mix of private and public lands managed for maintenance of native ecosystems and landscape integrity is required. Discussions with the agricultural sector of the economy should focus on maintaining natural areas on private and public leased lands as much as possible and on simulating natural processes within agricultural ecosystems wherever practicable. Research and education are needed to set the stage for fulfilling this recommendation.

(7) The agricultural and industrial sectors of the economy must be provided both public relations and economic incentives by a public which desires ecosystem protection. "Realigning the interests of wildlife and crops must comprise effective partnership between producers and consumers ... and an offsetting of costs by direct revenues" (Thomas 1988). Introduction of the North American Waterfowl Management Plan has been an important international step in this direction. Implementation of the North American Waterfowl Management Plan by its Committees (1986, 1988) is an excellent case in point of such stated intentions being put into practice.

(8) Beyond focusing attention on biological diversity, this very diversity ultimately is placed in jeopardy given management rigidity. Hence, flexibility and diversity of the management process itself is a long-term requirement for sustainable ecosystem process management.

ACKNOWLEDGEMENTS

I wish to express my thanks to Tim Lash, Environment Canada and others who provided comments. The lively discussion which followed presentation of this paper has resulted in some additions to the recommendations provided in this paper and, for this input, I am thankful. The opinions expressed in this paper are those of the author and do not necessarily reflect those of the Government of Saskatchewan.

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PROTECTION AND MANAGEMENT OF TALL-GRASS PRAIRIE IN MANITOBA

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Note: This paper is an update of Joyce and Morgan (1989).

The tall-grass prairie is the most endangered major ecosystem in Canada. In the black-soil region of Manitoba's Red River Valley, it now occupies an area 1/20th of 1% of the area occupied in pre-settlement times. Outside its true range, relatively large remnants, up to 256 ha in size, have been identified on stony or poorly-drained soils. The Manitoba Naturalists Society's Tall-Grass Prairie Inventory and Conservation Project (1987-1989) identified sites in the historical range through aerial and ground surveys. Subsequent conservation activities include the acquisition of two sites, landowner contact, extension (production of a brochure and a 20-minute film) and input into World Wildlife Fund's Prairie Conservation Action Plan and Manitoba's Provincial Prairie Conservation Strategy. Manitoba's Parks Branch has recently embarked on a 240 ha prairie re-establishment in Beaudry Provincial Heritage Park. Two major goals of the Tall-Grass Prairie Conservation Project are the establishment of a tall-grass prairie preserve and development of landowner incentives for prairie conservation.

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RECOVERY TEAMS AND RECOVERY PLANS

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INTRODUCTION

The objective of this session is to discuss recovery plans for endangered species and to determine the factors that go into making a useful, effective, and workable recovery plan. To date, recovery plans for the Whooping Crane (*Grus americana*) and the Peregrine Falcon (*Falco pergrinus*) have been completed and published. A number of plans are being developed including plans for Wood Bison (*Bison bison athabascae*), Swift Fox (*Vulpes velox*), Piping Plover (*Charadrius melodus*), Burrowing Owl (*Athene cunicularia*), Ferruginous Hawk (*Buteo regalis*), and Loggerhead Shrike (*Lanius ludovicianus*). Development of recovery plans is a relatively new endeavor in Canada, a process which has recently been accelerated by the formation of RENEW, a committee responsible for the REcovery of Nationally Endangered Wildlife.

RENEW is a program endorsed by provincial and territorial wildlife agencies to improve the status of endangered species in Canada. The RENEW committee includes directors of wildlife for the provinces and the territories and three national conservation agencies and is chaired by the Director General of the Canadian Wildlife Service. The secretariat for RENEW is also provided by the Canadian Wildlife Service. The mandate for RENEW is to review the COSEWIC list of endangered species and rank the species with respect to their plight and potential for recovery. The committee will appoint recovery teams and the teams will consist of various experts from federal and provincial governments and national wildlife agencies or universities. The recovery teams will look at the problems facing a particular species and develop a program that is designed to recover the species to a specific population size and distribution with the eventual aim of getting the species off the endangered species list. Recovery plans must be implemented by various agencies including government and nongovernment organizations so that the objectives of the plan are met.

There is no legislative base to RENEW. In contrast, there has been an Endangered Species Act in the United States since 1973, giving it a 16-year history. In the United States, the U.S. Fish and Wildlife Service is responsible and accountable for implementing the Endangered Species Act, for developing recovery plans, and for ensuring the work gets done. The Canadian situation has established what might be called a gentlemen's agreement between wildlife directors that they will do something about endangered species. Although the wildlife directors are gentlemen of unquestionable integrity, this still appears to leave a lack of responsibility and accountability for undertaking work to improve the lot of endangered species. Without legislated responsibility, it is conceivable that, although they endorse RENEW, wildlife directors could use a lack of resources as reason for failing to undertake meaningful programs for endangered species recovery.

Recovery plans provide a framework within which various projects can be undertaken in a coordinated manner by various agencies such as federal, provincial, local, and private organizations. The plan focuses effort into a concentrated program to improve the status of a particular species. The broad objectives of the recovery plan should be further refined and detailed in provincial/territorial action plans that commit individual stakeholders to specific recovery actions. Eventually, a recovery plan will be prepared for each threatened and endangered species. The plan may be simple or complex, depending on the particular circumstances of the species, and may require a number of agencies to become involved.

At this point, we can turn our attention to the two recovery plans which have been completed and also look at one plan that has reached the draft stage. Here, the objective is to find good and bad points about each plan and to identify some of the ingredients that should go into a good recovery plan.

PEREGRINE FALCON RECOVERY PLAN

By the 1970s, it was widely known that the peregrine was in trouble. In the 1980s, surveys in Canada and the U.S. indicated that there were continuing problems. Recovery efforts were underway as early as 1972 but there was no plan to guide these efforts, which were simply the best thoughts of agencies and individuals at that time. Around 1982, the Western Wildlife Directors agreed that there should be a recovery plan and that the Western Raptor Technical Committee should draft the plan. The first draft was authored by Gary Erickson of Alberta Fish and Wildlife Division and Richard Fyfe of Canadian Wildlife Service. The draft plan went to the national wildlife directors in 1985. After some modification, it was approved in principle in June 1986 and a recovery team was nominated.

The Plan describes some background and history on the species, defines problems, describes population status and assumptions, and includes goals. Goals must be measurable, achievable, and have a deadline if they are to be useful and realistic. These are difficult things to predict. How can we predict how well a species will recover and what numbers can be achieved? If the plan is too ambitious, failure is likely. If the plan is not ambitious enough, the goal may not be worthwhile. It is difficult to determine goals. The objectives of the peregrine recovery plan were based more on realistic numbers of reintroduced pairs than on the population size needed to create a self-sustaining population. Two objectives are (1) to establish by 1992 a minimum of 10 territorial *anatum* pairs in each of six zones defined in the plan and (2) to establish by 1997 in each of five of those six zones a minimum of 10 territorial *anatum* pairs naturally fledging 15 or more young annually, measured as a 5-year average commencing in 1993 (Erickson et al. 1988). The plan reviews the limiting factors for Peregrine Falcons, determines what management actions are required to overcome the limiting factors, ranks those actions within priority one, two, or three, and identifies activities year by year.

The plan and the recovery team members have benefitted from increased communication by getting together people who work on peregrines. This provides an opportunity to discuss release successes such as the return of 10 pairs in Quebec in 1988. It also allows fast transfer of information between various peregrine workers. Through discussion, emphasis on different projects was set and protocols for toxic surveys were developed.

We need guidelines for writing recovery plans that recognize the realities of wildlife management in Canada. One stumbling block has been the implementation schedule which was based on the U.S. schedule and which Canadian wildlife directors would not accept. The schedule had to be modified to reflect the Canadian circumstances.

Wildlife managers do not like to be pinned down, so a disclaimer was added to the plan saying that no agency has to do anything that it does not want to do. This is acceptable in the sense that wildlife agencies could spend all their budget on endangered species.

WHOOPING CRANE RECOVERY PLAN

Whooping Cranes were first recorded in prairie Canada in 1748. There are scattered breeding records for the Whooping Crane within the prairies and parklands of Manitoba, Saskatchewan, and Alberta from 1871 until 1922 and perhaps as late as 1927. Whooping Cranes are protected under the Migratory Birds Convention Act of 1916. The Canadian Wildlife Service (CWS) has the legal mandate for conservation of Whooping Cranes in Canada. A significant role has been played by the Canadian Parks Service, the provinces, the Saskatchewan Natural History Society, the Saskatchewan Wildlife Federation, and, especially in the early years of the program, by the Saskatchewan Museum of Natural History (namely Fred Bradshaw, Fred Bard, and Fred Lahrman).

The Canadian Whooping Crane Recovery Plan had its origins in 1981 when E. Kuyt (CWS) wrote the first draft. In April 1985, the Canadian Wildlife Service and the U.S. Fish and Wildlife Service signed a Memorandum of Understanding on the Conservation of Whooping Cranes to enhance cooperation between our two nations and as a basis for development of National Whooping Crane Recovery Plans. The U.S. Recovery Plan was approved in December 1986 and the Canadian Recovery Plan was approved in December 1987. Canadian and U.S. Recovery Plans are closely integrated and each plan represents a course of action to be carried out in the respective country.

In the Canadian Recovery Plan, there are sections on general biology, objectives, regional implementation programs, a contingency plan in the event of an accident, and the Memorandum of Understanding with the U.S. Fish and Wildlife Service. The Canadian Recovery Plan and its appendices contain the following broad objectives: (1) to provide for the welfare and expansion of the existing wild population of Whooping Cranes breeding in or near Wood Buffalo National Park and to increase the number of breeding pairs to 40 by the year 2000, (2) to protect Whooping Cranes and their habitat in Canada at places other than Wood Buffalo National Park by monitoring passage and staging in spring and autumn and developing and implementing a public information program to stimulate public response and support for implementation of this plan, (3) to expand the breeding range of Whooping Cranes in Canada, (4) to develop and enhance coordination within Canada and between Canada and the U.S. and maintain and implement the Memorandum of Understanding between Canada and the U.S., (5) to ensure the efficient implementation of this plan (Each flock being studied or created will be the subject of an integrated management plan.), and (6) to create a National Recovery Team and Regional Advisory Council to undertake an annual review of the existing program to determine if changes are required, to assess progress in reaching stated objectives and to ensure that high priority is given to developing and maintaining clear lines of communication among the cooperators and general public (Cooch 1988).

The Canadian Whooping Crane Recovery Team consists of the Canadian Whooping Crane Coordinator (CWS), Regional Whooping Crane Coordinator (CWS), Chief Park Warden of Wood Buffalo National Park, representatives from the governments of Manitoba, Saskatchewan, Alberta, and the Northwest Territories, and the Chairman of the U.S. Whooping Crane Recovery Team. The recovery team also has an Advisory Council consisting of the Whooping Crane Conservation Association, Saskatchewan Natural History Society, Saskatchewan Wildlife Federation, Head of the Threatened Species Section of CWS, Whooping Crane biologist from CWS - Saskatoon, Field Studies Warden at Wood Buffalo National Park, and World Wildlife Fund.

Good points of the Plan include its provision of a contingency plan, provision of a framework for future studies, and justification for existing programs in Canada. The Plan is flexible and the wording is general enough that new initiatives can be accommodated through amendment to the Plan.

The Plan has problem areas. It is subject to funding cuts and personnel changes in the cooperating agencies. In light of this, there is a disclaimer in the Plan that "The achievement of goals, objectives and specific projects identified herein and in the appendices, will be contingent upon priorities and budgets available to the participating agencies and organizations. Therefore, some aspects of this Plan may not necessarily be implemented immediately or concurrently." The Plan is not adventurous or specific enough regarding enhancement of the population and there is no mention of specific projects to release Whooping Cranes in areas formerly inhabited by the species.

WOOD BISON RECOVERY PLAN

Unlike the Whooping Crane and Peregrine Falcon recovery plans, a recovery committee was formed before the development of a recovery plan was started. In 1986, under the mandate of the Western Wildlife Directors Committee, the objectives were identified and a Wood Bison Recovery Team was established with representatives from each jurisdiction. In addition, a member from Canadian Parks Service, Elk Island National Park, was included in the recovery team because of their responsibility for managing the herd used for transplants.

The mandate for the Wood Bison Recovery Team from the Western Wildlife Directors was to first prepare a status report for COSEWIC; this was produced in December 1988. Based on this report of the recovery that has taken place to date, the status of the Wood Bison was downlisted from endangered to threatened in June 1988, as recommended by the recovery team.

The second assignment for the recovery team is development of the recovery plan itself. The first draft has been prepared. Development of the draft recovery plan benefitted from having draft and final copies of Whooping Crane and Peregrine Falcon recovery plans. The plan for Wood Bison, by incorporating the good points of those finalized plans, should be a superior plan. The format includes a brief history of the program and recovery of the subspecies to date. It incorporates the management plans for each jurisdiction where Wood Bison will be established including the Northwest Territories, Alberta, Manitoba, and the Yukon. In addition, the province of British Columbia has expressed an interest in releasing Wood Bison there. Development of the plan has resulted in bringing together the individual provincial and territorial management plans to document a coordinated effort for the recovery of the Wood Bison. The goals and objectives, national in perspective, are (1) to perpetuate the Wood Bison as an integral part of the native fauna of Canada through the maintenance of genetic integrity and specific disease-free status of various populations (This implies increasing the numbers and geographic distribution throughout their historic range.) and (2) to plan for a variety of uses of Wood Bison by Canadians, including tourism, hunting, and commercial development.

The goals and objectives of governments involved at each of the reintroduction sites are to be included in the plan. These are in various stages of preparation and will vary by jurisdiction. A national recovery plan will bring all the cooperators together to further the conservation of the subspecies. The Wood Bison has a definite advantage over the endangered birds in that resource use can and will take place with subsequent economic returns through harvesting or other endeavors. Also, conservation, the wise and sustained use of the resource, will help to perpetuate the integrity of the subspecies.

The recovery plan will include various habitat evaluation and management plans, population management plans, and information on the international status of the Wood Bison. Also, it will include a section on research requirements to attempt to define clear criteria with which subspecies can be identified.

Commercial development of Wood Bison and the disposition of surplus stock are current problems to the recovery of Wood Bison that will not be resolved in the near future. The Wood Bison Recovery Team has identified five means of disposition of Wood Bison including live sales, which is the most controversial, sport hunting, releases to the wild, sales to the meat industry, and display herds.

Factors limiting the recovery of the Wood Bison, such as the diseased hybrid issue in and around Wood Buffalo National Park and Plains Bison (*Bison bison bison*) within the historic range of Wood Bison, are topics being discussed. The good and bad points of the plan are yet to be determined as it is still in draft form and has not been approved.

GENERAL DISCUSSION - DEVELOPING RECOVERY PLANS AND TEAMS

Following the presentations, the chairman asked for feedback on accountability in terms of pinning down the wildlife directors of the various agencies for definite actions. There was some discussion and it was suggested that national wildlife organizations on the RENEW committee and/or on individual recovery teams would act as watchdogs over the process and ensure that commitments were carried out.

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MANAGEMENT AND RESEARCH NEEDS FOR BAIRD'S SPARROWS AND OTHER GRASSLAND SPECIES IN MANITOBA

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Population and range declines among Baird's Sparrows (*Ammodramus bairdii*) have contributed to a recommendation of threatened status in Canada (Wershler 1987, De Smet and Miller in prep.). In 1985, World Wildlife Fund Canada funded a survey on the status and abundance of the Baird's Sparrow in Manitoba (Ratcliff 1987). During 1987 and 1988, the Manitoba Department of Natural Resources in conjunction with World Wildlife Fund Canada and the Manitoba Naturalists Society conducted a study of the status and habitat preferences in Manitoba.

Survey efforts centered in southwestern Manitoba where most of Manitoba's rare and endangered grassland species occur. Other townships in southern Manitoba that had abundant grasslands were also visited. Forest inventory maps for these townships were obtained and used to locate suitable grasslands. Records were also kept for grassland species with a more limited distribution in Manitoba including the Sprague's Pipit (*Anthus spragueii*), Grasshopper Sparrow (*Ammodramus savannarum*), Chestnut-collared Longspur (*Calcarius ornatus*), Upland Sandpiper (*Bartramia longicadua*), Marbled Godwit (*Limosa fedoa*), and Willet (*Catoptrophorus semipalmatus*).

Some work on nesting biology and productivity was conducted during late July and early August 1988. A rope drag was used to find nests with eggs whereas adults carrying food were observed to find nests with young. When an adult was flushed from the nest, a nest search was conducted. If a nest was not found, the site was flagged and dragged again later. Sometimes the identity of the bird was not ascertained until a subsequent visit. Other species nesting in conjunction with Baird's Sparrows at this time of the year were Sprague's Pipits, Grasshopper Sparrows, Savannah Sparrows (*Passerculus sandwichensis*), and Chestnut-collared Longspurs.

Nests were revisited at about weekly intervals to assess nest success. Young were banded with aluminum and colored plastic bands. Mist nets were occasionally set up near nests to catch and band adults. A total of 25 juveniles and nine adults were banded.

DISTRIBUTION

Baird's Sparrows were recorded at 432 different sites from 1985 to 1988. Although primarily restricted to southwestern Manitoba, there were isolated records east to Winnipeg and north to Dauphin. A major influx appeared to have occurred during 1988, probably due to drought conditions throughout much of the Northern Great Plains. Despite windy conditions, we recorded 13 Baird's Sparrows on the Mather Breeding Bird Survey in south-central Manitoba during 1988 where one is usually cause for excitement. Most were in unusual habitats such as cropland or very small, idle lowlands within cropland.

HABITAT

The habitat at 422 of the sites used from 1985 to 1988 consisted of 54% pastureland, 29% hayland, 13% idle, and 4% cropland. Habitat was also assessed to within 1/4 mile (0.4 km) of a route through prime grassland habitat from the extreme southwest to Oak Lake; 80 singing males were recorded in 133 three-minute stops along this route on the morning of 15 June (Table 1). Although 38% of the available habitat along this route was cropland, only two Baird's Sparrows were found in crops (0.06 birds/100 ha). Pasture was the next most common habitat with about one-third of the available habitat and 34 Baird's Sparrows (1.23/100 ha). One-quarter of the available habitat was hayland and 31 Baird's Sparrows were found here (1.66/100 ha). Although only 5% of the available habitat was considered idle, Baird's Sparrow densities in this habitat were 3.17/100 ha. Hence, densities in idle areas along the route were about twice those in haylands, two and a half times those in pastureland, and 80 times those in cropland.

Although Baird's Sparrows were found in a variety of crops in Manitoba, it is doubtful that they nested there. Most were probably vagrants or were searching for food in croplands. Adults frequently hunted in a wheat field adjoining one native hayland. It is possible that Baird's Sparrows occasionally nest in weedy low

Table 1. Baird's Sparrow (BASP), Grasshopper Sparrow (GRSP), and Sprague's Pipits (SPPI) numbers and habitat preferences along a 66.5 mile survey route in southwestern Manitoba, 15 June 1988.

HABITAT	Ha.	% OF TOTAL AREA	BASP No.	BASP No./100 ha.	GRSP No.	GRSP No./100 ha.	SPPI No.	SPPI No./100 ha.
Cropland	3143	38.4%	2	0.06	0	0.00	1	0.03
Pasture	2762	33.7%	34	1.23	21	0.76	36	1.30
Hayland	1872	22.8%	31	1.66	4	0.21	12	0.64
Idle	410	5.0%	13	3.17	6	1.46	2	0.49

spots or in extremely weedy crops but this remains to be demonstrated.

Based on the literature, the higher densities in sites judged to be idle was not surprising. However, when most sites are left idle for several years, the understory and shrubbery often becomes too dense to support large populations. On some crown holdings, populations have probably dwindled due to lack of management. Baird's Sparrows can probably cope better with land left idle in drier, short-grass portions of their range.

Baird's Sparrows in pasture usually select the longer and lusher vegetation offered by lowland draws. This allows them to inhabit pastures of various grazing intensities. Nevertheless they were almost three times more common in lightly- or moderately-grazed pastures than in pastures grazed more than average. Although Baird's Sparrows are reputed to avoid dense shrubbery, along the route they were almost as common in pastures with more than 50% shrub cover as in pastures with 10 to 50% shrub cover. Surprisingly, they were one-third as common in pastures with less than 10% shrub cover. In pastures with more than 50% shrub cover, there was probably sufficient shrubless area to support Baird's Sparrows, although total densities in these pastures were probably less than in similar pastures with less shrub cover. Field work during late July revealed that Baird's Sparrows avoided heavy shrubbery although they occasionally nested just outside dense shrub patches.

Baird's Sparrows were more common in native haylands (5.00 birds/100 ha) than in any other habitat along the route. They were also unusually common in alfalfa/brome haylands (1.53/100 ha). One of the study areas that supported the greatest densities of Baird's Sparrows in late July was a rolling alfalfa field that had been mowed earlier in the year. These observations are contrary to most of the supposed habitat requirements, namely undisturbed, native, and flat terrain. Baird's Sparrows were indeed nesting here as two active nests were found within 10 m of each other. Sprague's Pipits were also found nesting in the center of this alfalfa field. What made this alfalfa field so ideal was not determined; however, the understory was noted to be lush and contained native vetches and grasses.

Haying also appears to have little effect on Baird's Sparrows, although regular haying probably removes the lush understory and discourages future occupancy. Two of the native haylands that were examined had been hayed just prior to or while we were conducting nest drags. Baird's Sparrow nests in these areas were situated on the ground, often in a scrape, and were not affected by mowing. Grasshopper Sparrow and Sprague's Pipit nests also did not seem to be affected. Although haying machinery probably crushed a percentage of the nests and others were left more vulnerable to predators, we attributed no losses to haying operations.

NESTING ECOLOGY

Cartwright et al. (1937), in a study near Winnipeg, found that three of five regularly observed pairs had two broods in a nesting season. However, almost all subsequent references agree with Lane (1968) that the species normally raises only one brood per nesting season. Baird's Sparrows arrive on territory in Manitoba during the second week in May. No data on early nesting were collected. During late July, most pairs were incubating eggs and a few were feeding young. Of the 13 nests found, five hatched in early August, five probably hatched from 21 to 31 July and three hatched between 10 and 20 July. Hence the nesting season for many pairs extends over 3 months. Since the incubation period for Baird's Sparrows is 11 to 13 days, young fledge at 8 to 10 days of age and Cartwright et al. (1937) noted that second clutches were initiated 1 to 8 days after young left from the first nest, it is possible for Baird's Sparrows to have three clutches over a 2 1/2 to 3 month span. The similarly adapted but better studied Grasshopper Sparrow, for example, regularly has two to three broods per season. Since there appears to be a period of lesser singing activity between peaks in late May to early June and late June to early July, it is probable that many Baird's Sparrow pairs initiate two clutches and perhaps three within a single nesting season.

Four to five eggs is considered the normal clutch size for Baird's Sparrows. Because we were studying late nesting during 1988, clutch sizes were slightly smaller: six nests contained four eggs, one contained three, and one contained three eggs plus two cowbird eggs. Two of 13 nests during this study (15%) were parasitized by cowbirds although cowbird parasitism on Baird's Sparrow nests is reputed to be very rare. In contrast, three of five Grasshopper Sparrow nests (60%) and one of six Sprague's Pipit nests (17%) during 1988 were parasitized by cowbirds. Seven of 12 regularly monitored Baird's Sparrow nests were eventually successful, fledging 21 young (3.0/successful nest). Regular observations of nests may have contributed to lowered nesting success through increased predation and abandonment. In one instance, a Baird's Sparrow young may have been abandoned after two cowbird young were removed from a parasitized nest near fledging!

MANAGEMENT

Some management implications from these studies include:

(1) More baseline information is needed on abundance of the Baird's Sparrow and other prairie species along specified routes in prime breeding habitat throughout the range of the species. A major problem with this, however, is that the breeding range and preferred habitat probably shifts from year to year depending on moisture conditions. Any comparison of numbers from one year to another must take this into account. Social factors may also be important in determining whether Baird's Sparrows settle in one area or another and may contribute to what some authors have referred to as "colonial-like" aggregations.

(2) We know very little about the nesting ecology, specific habitat needs and limiting factors affecting Baird's Sparrows. Proper management depends on this information. Habitat needs also appear to differ widely in various portions of the Baird's Sparrow range. Management options such as grazing may be beneficial in lush grasslands of southwestern Manitoba but could prove detrimental in the short-grass plains of Saskatchewan and Alberta.

(3) Baird's Sparrows are not as habitat specific as some earlier researchers believed; their abundance in alfalfa/brome hayfields and grazed pastures in Manitoba attests to that. Whether this is a long-term adaptation or a short-term response to local conditions remains to be determined. More work on microhabitat features that attract Baird's Sparrows to these sites and on productivity in atypical habitats is needed.

(4) The decline of grassland habitat must be monitored across the prairies. Where prairie sites are protected in federal or provincial wildlife reserves or parks, Wildlife Management Areas, Ecological Reserves, etc., these should be managed to prevent shrub invasion. Agreements with landowners to protect prairie sites from cultivation and other negative impacts holds promise for the future. During 1988, funding from the Manitoba Habitat Heritage Corporation allowed us to lease several prairie parcels where Baird's Sparrows and other rare or threatened prairie species occurred.

(5) The effects of differing intensities and frequencies of burning, grazing, and mowing needs to be better documented, both in terms of nest site selection and productivity. The effects of pesticide and herbicide use also needs to be assessed.

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STATUS OF THE BAIRD'S SPARROW IN ALBERTA - 1987/1988 UPDATE WITH NOTES ON OTHER GRASSLAND SPARROWS AND SPRAGUE'S PIPIT

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Note: Natural regions, Mixed Grassland, Northern Fescue Grassland, and Central Parkland, are according to Achuff and Wallis (1977). Observations are from unpublished field notes of Cleve Wershler, Wayne Smith, and Cliff Wallis.

BAIRD'S SPARROW

Typical nesting habitat of the Baird's Sparrow (*Ammodramus bairdii*) is ungrazed or very lightly grazed fescue grassland or mixed grassland; Spear Grass (*Stipa comata*) in mixed grassland and Rough Fescue (*Festuca scabrella*) in fescue grassland make up the majority of the vegetation cover. Surficial deposits under prime habitat in mixed grassland in the Milk River area are glacial outwash while those in fescue grassland at Little Fish Lake are ground moraine. Characteristic habitats have well-drained, loamy soils.

The largest and densest populations of Baird's Sparrows have been found in extremely lush grasslands in (1) the Kennedy Creek area, south of the Milk River Canyon, in mixed grassland that had not been grazed for about 20 years and (2) west of Little Fish Lake in ungrazed fescue grassland which had a history of use as hay fields but which had not been mowed for 3 or more years. Both of these areas yielded consistently high numbers when surveyed during the 1970s. The Kennedy Creek area was grazed for a short time in the early 1980s but the effects of this on Baird's Sparrow populations was not investigated. The Little Fish Lake area was still productive in 1986, however, compared with the 1970s, more of the grassland had been mowed or heavily grazed and, therefore, there was less habitat suitable for Baird's Sparrows.

Extreme fluctuations in populations have been documented in natural mixed grassland. In June 1986, Baird's Sparrows were more abundant in the Lost River area than in any other year over a 12-year period. This followed a record maximum spring rainfall and unseasonably warm temperatures, conditions which produced an early growth of very lush grasses. Most birds appeared to be singing in the vicinity of low-lying areas.

In the Mixed Grassland of Alberta, Baird's Sparrows probably fluctuated greatly prior to European settlement responding to climatic fluctuations, fire, and shifting patterns of Bison (*Bison bison*) grazing. Lush grassland habitats would have occurred more regularly at the northern edge of the Mixed Grassland, in the Northern Fescue Grassland, and at the southern edge of the Central Parkland. Compared with the majority of the Mixed Grassland, these areas were moister and generally did not receive the same intensity of grazing by Bison. They could have offered more reliable habitat for Baird's Sparrows.

During 1988 field surveys in the Stettler-Castor-Coronation-Hanna region in the Central Parkland and Northern Fescue Grassland, singing Baird's Sparrows were found commonly in grassy portions of dry, alkali lake basins. Alkali grass (*Puccinellia*) was a dominant plant species in these habitats. The largest numbers of Baird's Sparrows were at Gough, Sullivan, and Lonepine lakes.

Baird's Sparrows are absent from vegetated sandhill habitats in the Mixed Grassland but numbers have been found singing in sand plain areas at the edge of sandhills where terrain is flatter and shrubs are sparser than in sandhills proper. Sites include the Pakowki Lake, Lost River, Little Rolling Hills, and Suffield areas. Cultivated fields do not appear to be extensively used by Baird's Sparrows in Alberta. Individuals or small, scattered numbers have been noted rarely in a mixture of Russian wild rye and native vegetation in the Lost River area and brome fields in the Big Valley, Sounding Lake, and Kirkpatrick Lake areas. In fescue grassland at Little Fish Lake, Baird's Sparrows are absent from grasslands mowed in the previous year (Owens and Myres 1973).

Recommendations

(1) Major habitats should be monitored for changes in abundance of Baird's Sparrows, land use changes, and condition and trend.

(2) More work is required in dry lake basins to assess reproduction, nesting success, and long-term use.

(3) A new management philosophy is needed in Alberta which will maintain a diversity of grassland habitats including lightly-grazed and periodically-ungrazed areas.

(4) Critical areas of habitat which are productive during drought periods should be protected.

(5) It is known that Baird's Sparrows are intolerant of heavily-grazed grasslands. However, it would be valuable to know what the critical level of grazing intensity is in the major habitat types when significant declines of Baird's Sparrows occur.

(6) Emphasis should be placed on protection of natural habitats. Cultivated and marginal areas should be given lower priority in conservation programs for the species.

(7) The COSEWIC status recommended for Alberta is rare.

BREWER'S SPARROW

The Brewer's Sparrow (*Spizella breweri*) is locally common in the Mixed Grassland and rare in the Northern Fescue Grassland and Central Parkland. Natural habitats used include sagebrush (*Artemisia cana*) and occasionally Silverberry (*Elaeagnus commutata*) in sandhills and sagebrush communities on sandy soils (sagebrush flats on clay soils do not seem to be as well used). One of the largest and densest concentrations was found in the Lost River sandhills in mainly Silverberry with rose understory and some sagebrush.

LARK SPARROW

The Lark Sparrow (*Chondestes grammacus*) is local in the Mixed Grassland and Central Parkland where it is associated with semi-open areas in river valleys and coulees as well as sandhills. Natural habitats used include grassland-badland ecotones usually with an element of sagebrush, sandhills usually with scattered cottonwoods (*Populus deltoides*), river bottoms in sandy areas (woodland-sagebrush ecotone), and sandy parkland in the Wainwright area. This species was regularly seen in 1988 in edge habitats in cultivated upland in the Empress-Bindloss area, formerly sandplain grassland. Large populations occur along the lower South Saskatchewan River; other populations occur along the lower Milk River and lower Red Deer River valleys and in the Middle Sandhills.

GRASSHOPPER SPARROW

Grasshopper Sparrows (*Ammodramus savannarum*) are locally common in the Mixed Grassland, rare in the Central Parkland, and local and uncommon in the Cypress Hills. They favor a mixture of lush grasses and low, relatively-open shrubbery and are intolerant of heavy grazing. This species is most typically found in sandhills. Occasionally it is found in lush grassland on sandy soil (e.g., Lost River and Chappice Lake) and seasonally wet meadows in the Cypress Hills. This sparrow has been found rarely in exotic grasses (e.g., cultivated brome at Ribstone Creek south of Wainwright and crested wheat in an abandoned farmstead near Dinosaur Provincial Park).

MCCOWN'S LONGSPUR

McCown's Longspur (*Calcarius mccownii*) is locally common in the southeastern portion of the Mixed Grassland. Its range is smaller and more localized than that of the Chestnut-collared Longspur (*Calcarius ornatus*). Like the Chestnut-collared Longspur, this species requires moderately-grazed to heavily-grazed grassland but differs in showing a preference for drier, sandier sites. The major range is south of the Cypress Hills, especially the Milk River-Lost River area west to about Pakowki Lake. Another population is located north and west of Medicine Hat.

CHESTNUT-COLLARED LONGSPUR

The Chestnut-collared Longspur is common in the Mixed Grassland and local in the Northern Fescue

Grassland. This species ranges farther north and west than the McCown's Longspur. It requires moderately- to heavily-grazed grasslands including moister sites than those frequented by the McCown's Longspur. In fescue grassland at Little Fish Lake, birds colonized recently-mowed sites (Owens and Myres 1973).

SPRAGUE'S PIPIT

The Sprague's Pipit (*Anthus spragueii*) is local in Mixed Grassland, Northern Fescue Grassland, and Central Parkland and is more widespread and abundant than the Baird's Sparrow. It inhabits lush grassland habitats similar to those of the Baird's Sparrow, including dry lake bottoms, but the habitat tolerance of the Sprague's Pipit appears to be broader. It is able to inhabit some moderately-grazed areas, sites which are too heavily grazed for Baird's Sparrows, as well as some grassy sites in the sandhills proper which are not inhabited by Baird's Sparrows. This species is a common associate of the Baird's Sparrow and, like that species, it is intolerant of heavy grazing.

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BAIRD'S SPARROW AND MISCELLANEOUS GRASSLAND BIRDS - SUMMARY OF DISCUSSION

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Although this session focused on the status and management of the Baird's Sparrow (*Ammodramus bairdii*), other grassland species of concern were discussed. Participants were asked to come up with a list of species of concern in their jurisdiction, information needs for these species, major limiting factors, efforts underway to alleviate perceived problems, suggestions on how to meld agricultural practices with preservation of these species, and an action list of plausible management strategies.

In Alberta, the Baird's Sparrow was listed as rare. Plenty of potential habitat is currently available for the species but lack of management has left unsuitable conditions in much of this habitat. Other sparrow species were considered locally common, especially in sandhill areas. Grasshopper Sparrows (*A. savannarum*) were considered intolerant of grazing; Lark Sparrows (*Chondestes grammacus*) and Brewer's Sparrows (*Spizella breweri*) were much more tolerant. Sprague's Pipits (*Anthus spragueii*) in Alberta have a wider distribution than the Baird's Sparrow, exhibit greater habitat flexibility, and are more tolerant of moderate grazing.

In Saskatchewan, declines in Baird's Sparrow populations are evident and the species is considered to be as threatened as any of the species discussed. Heavy grazing, combined with the effects of the recent drought, have had a pronounced negative influence on Baird's Sparrow populations. Over the years, Wayne Harris has made over 2800 observations of Baird's Sparrows in Saskatchewan, 96% of these were in native grasslands, 2% in seeded grasslands, 2% in alfalfa, and under 1% in crops. Wayne felt that the Sprague's Pipit was also not adaptable in its habitat preferences and was probably close behind the Baird's Sparrow in terms of vulnerability in Saskatchewan. Of 1600 observations of the Sprague's Pipit in Saskatchewan, 93% were in native grasslands, 4% in seeded grasslands, 2% in alfalfa, and less than 1% in crops. Grasshopper Sparrows were considered locally common, especially in sandy areas; of 8200 observations over the years, 83% were in native grasslands, 17% were in seeded grasslands, and none were in alfalfa or crops. McCown's Longspurs (*Calcarius mccownii*) were considered locally common in the short-grass prairies of the southwest; habitat associated with observations included 78% native grasslands, 13% seeded grasslands, 2% croplands, and 7% summerfallow.

Although the Baird's Sparrow exhibits more habitat flexibility in Manitoba than in the other prairie provinces, population declines and a limited distribution contribute to a threatened status in the province. As in Alberta, the Sprague's Pipit has a wider range of habitat preferences and a larger distribution than the Baird's Sparrow. Although it is locally common in a few sites, low numbers in most areas warrant concern status in Manitoba. Grasshopper Sparrow numbers and distribution in Manitoba are much reduced compared to Alberta and Saskatchewan. Despite a wider range of habitat preferences, its scarcity justifies a threatened status for Manitoba. The Chestnut-collared Longspur (*C. ornatus*) is locally common in pastures of southwestern Manitoba. Due to a limited and reduced distribution in the province, however, concern status is assigned to this species.

Some participants in this session were concerned that too much emphasis is being placed on the status of individual species rather than on protection of the grassland complex. Indeed, as more and more grassland areas are lost or altered, an array of grassland specialists including the Baird's Sparrow, Sprague's Pipit, and even the Western Meadowlark (*Sturnella neglecta*) are becoming increasingly imperiled. Nevertheless, studies of individual species are useful in focusing our attention on the status of their habitat. Since the Baird's Sparrow is usually restricted to native or native-like prairie grasslands and has adapted poorly to other types of habitat, it is probably one of the best indicator species on the status of native prairie grasslands.

SUGGESTIONS FOR BREEDING BIRD ATLAS PROJECTS IN SASKATCHEWAN AND MANITOBA

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At the 1986 conference on endangered species in the prairie provinces, I summarized methodologies and results from the Ontario Breeding Bird Atlas (Cadman 1987a) and made suggestions as to the advantages of undertaking similar projects on the prairies (Cadman 1987b). The main points presented in those papers are still pertinent and will not be repeated here. With an atlas underway in Alberta, this paper provides more detailed suggestions for consideration by those contemplating atlas projects in Saskatchewan and Manitoba.

The Prairie Conservation Action Plan (PCAP) (World Wildlife Fund Canada 1988) provides some valuable incentives for atlas work on the prairies. According to PCAP, "Every Vulnerable, Threatened or Extirpated species and their habitat must be protected" and we must "ensure that no additional species become Threatened, Endangered, or Extirpated." Breeding bird atlas projects can help in the realization of these goals by attaining widespread coverage and thereby identifying breeding locations for Vulnerable, Threatened, or Endangered species. Effective research and conservation efforts will be greatly enhanced by this knowledge. Atlas data will also help identify additional species deserving COSEWIC designation.

CHOICE OF GRID SYSTEM

The Universal Transverse Mercator (UTM) grid has proven to be well suited to breeding bird atlas work in Canada and is highly recommended for use in both Saskatchewan and Manitoba. Consistency across the country is highly desirable for comparative means and to facilitate the sharing of data and technology. The advantages of the UTM system are described in Udvardy (1981). The UTM system provides an excellent basis for building further atlas-style projects in the future; international experience indicates that the breeding bird atlas may be only the first of many such ventures.

SCOPE OF THE PROJECTS

Given the small population relative to land area in both provinces, a two-tier system of data collection similar to that used in Ontario is recommended. Such a system calls for intensive coverage by relatively small quadrats in the more accessible and populated southern portion of each province with less intensive coverage using larger quadrats in the remote north. The southern part of Ontario was covered on the basis of 10 x 10 km UTM "squares" while northern Ontario was covered on the basis of 100 x 100 km "blocks." The northern edge of the prairie is the logical boundary between two such zones in Saskatchewan but, in Manitoba, additional area to the east and northeast of the prairie could probably be accommodated in the zone of intensive coverage.

As is true of any atlas project, the goal in each province will likely be to provide more than a specified minimum amount of coverage within each quadrat. However, to ensure maximum value of the information collected in the northern zone, data should be recorded on the basis of the smaller-sized quadrats used in the southern zone. Significant sightings should be located to the 100 x 100 m UTM quadrat, or as precisely as possible.

The considerable logistical difficulties of covering remote northern areas and the critical need for information on bird distribution and abundance on the prairies indicate that coverage of the southern zone should be emphasized in each province. Remote area work could be given emphasis when adequate coverage of the south is clearly in hand or when it will not interfere with coverage of the southern zone.

The southern zone of Manitoba accommodates roughly 500 to 600 quadrats of 10 x 10 km and the southern zone of Saskatchewan accommodates roughly 400 quadrats of 20 x 20 km. Coverage at those levels should be manageable with the enthusiastic support of naturalists, government agencies, and other professionals.

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BREEDING BIRD ATLAS SESSION - SUMMARY OF DISCUSSIONS

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There can be no doubt about the benefits of having a Breeding Bird Atlas for each jurisdiction in Canada. But, is it feasible to use the same Atlas sampling methods in provinces such as Manitoba and Saskatchewan given the limited manpower and resources available? If such a project were attempted, should the methodology follow standard atlas techniques or be modified for our unique circumstances? No doubt these are questions other jurisdictions have dealt with and obstacles they have overcome while preparing Atlases. By bringing up these topics at this Conference, it was hoped that the impetus might be provided towards initiation of official Breeding Bird Atlas efforts in Manitoba and Saskatchewan.

In this session, three different perspectives were presented on Breeding Bird Atlas methodology. Mike Cadman gave an analysis of the recently completed Ontario Breeding Bird Atlas - what they did right and where they fell short. Jack Clements presented a discussion on the recently initiated Alberta Breeding Bird Atlas. Al Smith discussed the nearly completed Saskatchewan Bird Atlas, an effort that differs from most other atlases in that historical data as well as migration and wintering data are included.

Topics of discussion included whether the Universal Transverse Mercator Grid (UTM) system is superior to use of latitude-longitude (lat-long) blocks. Ontario, Alberta, and most other atlas efforts have utilized the UTM system, making this system more useful for comparability. Nevertheless, where historical data are incorporated such as in the Saskatchewan atlas, the lat-long system is far easier to apply. Block sizes and coverage are also variable from one area to another. Ontario, for example, went with 10 km x 10 km blocks in the south and 100 km x 100 km blocks in the north where the results from one 10 km x 10 km block were extrapolated to reflect the composition of the larger 100 km blocks. Although organizers projected that it would take 16 hours per block to find 75% of the expected species, in the end an average of 57 hours were spent in each block. Alberta, in contrast, plans on sampling one 10 km x 10 km block in each 20 km x 20 km square; initial plans to spend 20 hours per block to find 75% of the expected species have proven unrealistic causing them to downgrade their target to 50% of the expected species.

After listening to the presentations and discussions in this session, I was left with the impression that conducting a true Breeding Bird Atlas effort in large, sparsely populated provinces such as Manitoba and Saskatchewan would be a major undertaking. Perhaps, as was mentioned at the first Endangered Species Conference, it might be more feasible and ultimately more useful and meaningful to undertake a Breeding Bird Atlas in the prairie and parkland regions of the Prairie Provinces. Nevertheless, the progress made by the Alberta Breeding Bird Atlas team proves that such an effort is possible given sufficient planning.

FEDERAL LEGISLATION AFFECTING ENDANGERED SPECIES

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INTRODUCTION

I will briefly review existing federal legislation affecting endangered wildlife, describe how it could be improved by amendment, and describe a hypothetical federal endangered species act.

Four pieces of legislation are relevant to prairie wildlife and habitat: the Migratory Bird Convention Act of 1917, the Canada Wildlife Act of 1972, the National Parks Act, and the Fisheries Act.

The Migratory Bird Convention Act provides federal powers to allow Canada to meet its commitments to the 1916 treaty on migratory birds with the United States. The act aims to protect certain migratory birds from direct harm, but it has its limitations. It omits some important groups of birds which migrate and which are in trouble, such as the raptors. Like many provincial wildlife acts, it provides no special protection for species that might be endangered. Lastly, it has weak reference to habitat protection.

The Canada Wildlife Act is a much more important statute for endangered species and for habitat. First of all, it specifically recognizes the need to give species at risk special attention and that habitat loss is their major limiting factor. It gives the Minister of the Environment a free hand, but does not require that he act. The Act provides the mandate for Environment Canada to cooperate with provincial governments and other parties in assisting endangered species under provincial jurisdiction. It provides the basis for acquiring and managing land for conservation within National Wildlife Areas. However, the Canada Wildlife Act does not designate those species which are endangered, or confer any legal status or special protection on them.

The National Parks Act grants the federal Environment Minister control over the management of all fauna and flora in federal parks. It has served very well in protecting important habitats of the Whooping Crane (*Grus americana*), Wood Bison (*Bison bison athabascae*), and Piping Plover (*Charadrius melodus*), for example. However, National Parks are a small part of the landscape. The Act does not require the government to give special attention to endangered species relative to other wildlife.

The Federal Fisheries Act provides solid protection for regulating harvests of all marine species and for protecting the habitat of anadromous fish, but it is less effective when it comes to freshwater fish. The federal government may have the responsibility for managing fish populations but, like the situation with migratory birds, the provinces control the habitat. Furthermore, the Department of Fisheries and Oceans has delegated certain management responsibilities to the provinces, rendering the situation different in each province. So the responsibility for endangered freshwater fish varies across the country and has attracted little federal or provincial attention.

AMENDMENTS

The first objective of amendments to existing legislation would be to extend special recognition and protection to endangered species under both provincial and federal jurisdiction. Provincial species would receive this special attention from provincial endangered species act or their equivalent. Federal species such as migratory birds, fish, and marine species, would be covered by amendments to the federal migratory bird convention and fisheries acts. These amendments would designate vulnerable and endangered species (the COSEWIC listed species) and provide special penalties for killing or in other ways interfering with them. To summarize, amendments to the provincial and federal (protection) laws would allow designation of all species of concern, thereby covering all fauna and flora. They would place higher penalties for interfering with any listed species, emphasizing the stick approach rather than the carrot.

We could still use legislation that offers the carrot approach, instilling in the public the desire to prevent endangerment. One step in that direction would involve amendments to the Canada Wildlife Act that allow adopting the COSEWIC list as an "official" national list, thus giving species that are at risk legal identity. The RENEW strategy for recovery of species could be adapted in the same way, insuring automatic recovery action for all listed species. Lastly, such an act might call for the establishment of an endangered species commission, a group of prominent citizens who report to Parliament annually on the state of efforts to preserve wild species. This group could help bridge the present gap between scientists, politicians, and the public. Such a commission has been successfully established in Australia.

NEW LEGISLATION

A new federal act for endangered species is another possibility. such an act would have as its purpose the designation of species, education of the public, prevention, and remediation. It would attempt to complement and support provincial legislation. Such an act could be administered jointly by the Environment and Fisheries Ministers, and they in turn would appoint a commission of prominent citizens as described for the Canada Wildlife Act. Such an act might contain the following features.

1)It would have a preamble that persuasively states the reasons for preserving species.

2)It would designate and list vulnerable, threatened, and endangered species, using COSEWIC and public consultation.

3)It would describe a recovery process for all species under federal jurisdiction (recovery plans, teams, and programs).

4) It would provide for financial assistance to provinces for the recovery of their species.

All of these features have been on the carrot side.

The act could have punitive features as well.

5)It would require all federal departments and Crown corporations to ensure that their actions do not jeopardize listed species. (This would perhaps be its most important feature.) To assure such protection by departments, it would provide for inter-agency consultation and participation in environmental impact assessments. Departments would have to publicly justify their actions and remediate any damage they cause to the interests of endangered species.

6)The new federal act could also designate a list of foreign endangered species and stipulate that all federal actions abroad respect the needs of those species. (It could also authorize sanctions against countries that do not, in Canada's opinion, honor their obligations to international conservation agreements.)

In summary, a federal endangered species act could take a truly national perspective and provide added protection for federal and provincial species alike. It could serve as a model for corresponding acts in the provinces designed to govern the activity of provincial government agencies.

Those of you familiar with the U.S. Endangered Species Act will recognize that some aspects of what I have proposed closely resemble the U.S. act; however, there would be two major differences. The Canadian act as I envision it would not provide federal penalties for harming species, be they under federal or provincial jurisdiction (these penalties would be found in existing wildlife acts). Compliance would be motivated by civic duty and public pressure rather than by fear of litigation.

ENDANGERED SPECIES AND HABITAT LEGISLATION

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INTRODUCTION

The objective of this session is to determine if new or amended legislation would help advance the goals of the Prairie Conservation Action Plan. Three of the Plan's 10 goals involve legislation action, as follows:

1)Goal #5 - Gather responsibility for all species under one department in each government;

2)Goal #6 - Create provincial and federal endangered species acts; and

3)Goal #8 - Create laws to conserve natural areas without infringing on agricultural production.

At the workshop, five speakers reviewed pertinent federal and provincial legislation and described planned or potential new legislation. During a concluding discussion period, they and the audience prepared recommendations for legislative development.

For years conservationists in Canada have talked about special laws to protect endangered species and habitats. Judging from the small number of references available on the subject, however, such legislation has received little serious attention, especially at the national level. One article has been published in a law journal (Versteeg 1984), another in the proceedings of an endangered species conference (Singleton 1977). There is an unpublished masters degree thesis available (Maurer 1985) and at least one consultant's report (Johnson and Weichel 1986). Why so little?

Developing wildlife law in Canada is a tricky business. It is a very specialized area, based on legal tradition and not on ecological reality. It is politically contentious. Traditionally, Canadians have used voluntary agreements or accords, rather than legislation, to solve problems. COSEWIC (Committee on the Status of Endangered Wildlife in Canada) is an example of such an agreement. This raises the question, do we need new laws?

New or better laws may offer considerable benefits. They can, for example, convey a powerful message to the public about the importance or priority of a subject. The U.S. Endangered Species Act has been a great attention grabber. The famous case of the snail-darter minnow halting construction of the Tennessee Valley Authority's Tellico Dam is a good example. Laws can also lead to new and benign social customs (Fitter 1986). If present social customs do not allow us to maintain conditions under which species thrive, it will be easier to pass a law than to change those customs. After a generation or two, a reasonable law may lead to the disappearance of harmful customs.

However, before we can discuss laws intelligently, we should be clear on what species the various levels of government are responsible for. The responsibility for managing and preserving the nation's fauna and flora is fragmented, divided into segments that are managed by three levels of government, 13 different jurisdictions, over 20 separate agencies, and over 30 statutes. The provinces have jurisdiction over the terrestrial vertebrates, invertebrates, and plants. Traditionally, they have exercised this responsibility through legislation dealing with game, wildlife, ecological areas or parks, and endangered species. The federal government has jurisdiction over most migratory birds, all fish, and all marine life. It also has responsibility for all fauna and flora on federal lands like National Parks, National Wildlife Areas, and Defence properties. It has powers in negotiating international agreements like the Convention on International Trade in Endangered Species (CITES), and in dealing with interprovincial trade. With management responsibility for flora and fauna so fragmented, it is not surprising that there has been a lack of enthusiasm for legal evolution; yet, this may be a major reason why we need it.

Saving endangered species and habitats is not so much a biological as a political and socio-economic challenge. With few exceptions, we already know how to rescue endangered species and prevent the endangerment of others. The hardest part is organizing our society to cope with the problem. This is where laws, as society's guidelines, can play an essential role.

As we review the effectiveness of our existing laws and consider amendments or new legislation in this session, we should keep four questions in mind:

1)Should laws focus on the source of a problem rather than on its symptoms? Many of our older wildlife laws focus on prevention of killing or disturbance when nowadays the main problem is habitat loss. In other words, should one deal with preventing endangered spaces before endangered species?

2)Would laws be more effective if they offered incentive for desirable behaviour rather than punishment for undesirable behaviour? In other words, offer a carrot instead of a stick.

3)Is some of the ineffectiveness of existing legislation due to lack of enforcement rather than weakness in the legislation itself? Two older provincial endangered species acts (Ontario and New Brunswick) have rarely been enforced. Do we need new legislation or better enforcement of existing legislation?

4)Should laws be strengthened so that conviction is automatic upon proof that an offence was committed? Some wildlife law (Ontario Endangered Species Act) is written so that the Crown must demonstrate not only that an offence was committed but that the defendant committed it wilfully. This makes it much harder to get a conviction.

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WORKSHOP RECOMMENDATIONS - ENDANGERED SPECIES AND HABITAT LEGISLATION

	AMENDMENTS	NEW
Provincial Legislation	1.Endangered species should not be names in legislation and given legal recognition 2.All wildlife species should receive automatic protection from killing and disturbance except those classed as game or pests 3.All biota should be referred to in legislation, not only "higher" organisms like the warm-blooded vertebrates	4.Create more incentive to private landowners to protect wildlife habitat 5.Introduce land-use bylaws at municipal level 6.Introduce a non-consumptive users tax to raise revenue for wildlife management 7.Designate management areas by ecological instead of political boundaries 8.Focus more attention on vulnerable species to prevent their becoming endangered
Federal Legislation		9.Investigate feasibility of endangered species act 10.Assess impact of all federal development projects on endangered species 11.Establish an endangered species advisory committee to the Minister of the Environment

ENDANGERED SPECIES AND HABITAT LEGISLATION/PROGRAMS - MANITOBA

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Existing legislation that has some relevance to endangered species and their habitat includes the Wildlife Act, Parks Act, Ecological Reserves Act, and Environment Act. An endangered species act is recommended legislation at this time. Examples of existing programs having some relevance are the Habitat Enhancement Land Use Program (HELP), Tall Grass Prairie Inventory, Ecologically Significant Areas program, Crown Land Classification program, Ribbons of Habitat program (Conservation of Rights-of-Way), Heritage Marsh Program, and Habitat Heritage Program. Examples of proposed and developing programs are the Sustainable Development Strategy and Piping Plover Protection program. Land allocations having some relevance include the Wildlife Management Areas, Sanctuaries, Heritage Provincial Parks and use-restrictive park zones, Ecological Reserves, and Voluntarily Protected Ecologically Significant Areas

The Wildlife Act was developed to facilitate game management through regulation of harvest. It is also the legislation used to identify indigenous wildlife species which may or may not be hunted. At present, any species may be hunted unless it is protected under the Act or some other act such as the Migratory Birds Convention Act. The Act therefore plays a major role in species protection in Manitoba since it is the first line of defence. It does not, however, effectively stop destruction of habitat or killing of wildlife except for game and fur-bearing species.

Regulation of harvest continues to be the major thrust of the Wildlife Act but the Act allows designation of endangered wildlife species and populations through Ministerial Order. However, it has not been used for this purpose. Specific reasons are not clear but seem to be related to the complexity associated with determining the degree of threat, identifying a single Minister with the authority, and then asking that Minister to unilaterally defend the designation. Even so, designation would not require preservation of habitat and hence would leave designated species susceptible to decimation through habitat destruction.

The Parks Act is the major legislation for administering lands as provincial parks. It specifies that parks be developed for conservation and management of flora and fauna, preservation of specific areas including those of ecological interest, and for recreation. As provincial parks in Manitoba can be used for a variety of purposes, they are generally viewed as recreation and multi-use areas where resource harvesting may occur. Harvesting activities range from angling and hunting to wild rice and timber harvesting. These activities are excluded from specific areas of parks through implementation of management plans and are excluded from some types of parks, notably heritage and wilderness parks.

The Ecological Reserves Act can be used for protecting endangered species on a site-specific basis. Ecological reserves provide rigorous protection of the reserves and everything found in them. This means that nothing can be removed from or deposited in an ecological reserve except under a permit issued by the Minister. Habitat management activities must also be approved by the Minister. (Advice on these matters is provided by the Ecological Reserves Advisory Committee.)

The ecological reserves approach is workable when specific populations of small, non-migratory wildlife are considered. It is not workable in instances where large home range areas must be protected or when private land is involved since ecological reserves can only be established on Crown land. The approach is also dependent upon knowing where self-sustaining populations of species at risk are located.

Recommendations have been received that Manitoba develop and pass an endangered species act. These recommendations have considerable support with current thinking focusing on facilitative legislation that could be used by any branch of any department. (People having an interest in this type of legislation might wish to review the New Brunswick and Ontario acts which have been in place for some time.) No doubt the Department of Natural Resources will have a keen interest in the act and could be designated the lead department.

Current thinking is that the act should relate to all organisms including plants and invertebrates. It should also deal with all forms and stages of the organisms and with protection of habitat. A pro-active perspective should be built into the act to allow for research and reintroduction activities by reputable organizations and individuals under controlled circumstances. In all probability, an advisory committee of members of the public and government personnel would be created to advise the minister responsible for the Act on designation of species and on endangered species protection. Designations would undoubtedly occur by Order-in-Council rather than by Ministerial Order and thus would be clearly identified as government policy.

It is very unlikely that the question of when a species is at risk can be answered by legislation. The processes currently used by COSEWIC, Ontario,and other groups involved with endangered species protection should be examined with an eye to balancing expediency with scientific security. Clearly, protection of endangered species cannot be effectively undertaken if processes for their protection are so time consuming that species are gone before they are protected or so expensive that funds continually fall far short of requirements. These aspects can, I believe, be addressed by the scientific community but we shall have to think as much of the species at risk as we do of the reputations at risk. It will be necessary to tread a fine line between losing species and losing credibility by crying wolf too often.

Terms of reference for today's presentation asked that habitat issues be addressed along with legislative issues. Rather than dwell on habitat, I shall refer to some programs which are probably already familiar to you but shall spend more time on programs that are not strictly wildlife programs but are useful to wildlife interests. The familiar programs include the Habitat Enhancement Land Use Program (HELP), the Ribbons of Habitat program, the Manitoba Heritage Marsh program, the Manitoba Habitat Heritage program, and the Tall Grass Prairie Inventory. The less familiar programs are the Crown Land Classification Committee's land planning program, the Ecologically Significant Areas program, and some heritage activities in Provincial Parks.

Heritage activities in Provincial Parks and in other types of parks are, in my opinion, a growth area relative to protection of threatened species and ecosystems. They should be encouraged and assisted wherever possible. In Manitoba, there are prairie restoration projects in provincial and in city parks as well as interpretive programs to sensitize the public. Along this same line of thought, it is recognized that significant examples of tall grass and other prairie ecosystems are protected in Wildlife Management Areas. I doubt that we know enough about what is already protected or the significance of these areas to effectively understand the current situation. It is, therefore, important to gather descriptive information on existing areas but I believe it should be done in tandem with efforts to identify new areas worthy of recognition and protection.

Proposed programs also merit recognition. Time does not permit a detailed review but I shall draw your attention to Manitoba's developing Sustainable Development Strategy and to the possibility that a Piping Plover (*Charadrius melodus*) protection program may develop. This latter program would build upon protection already provided by the Clandeboye Bay Special Conservation Area which was established specifically to protect Piping Plovers.

The Sustainable Development Strategy is broad having its origins in the World Conservation Strategy, the Brundtland Commission Report to the United Nations, and in the Report of the National Task Force on Environment and Economy. I suggest that the term sustainable development should be interpreted to mean that developments will be sustainable rather than that development *per se* is sustainable. One implication is that developments should also be looked at from the "environmentally friendly" perspective. The tie between endangered species and sustainable development is maintenance of genetic diversity through recognition that all domestic plants and animals have their "roots" in wild ancestry and that many have developed from narrow genetic bases. A secondary focus relates to the use of native plants in the landscaping and horticultural industries not to mention ecosystem restoration efforts. These thrusts are developing and seem to have considerable economic growth potential which would be lost if endangered species are lost.

Establishment of a Piping Plover protection program is under consideration in Manitoba. It is too soon to comment on what the program might involve except that public education, protection of additional habitat, and linkage with the national and continental programs would likely occur.

SASKATCHEWAN LEGISLATION RELEVANT TO ENDANGERED SPECIES

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Several types of legislation are required by managers in order to protect threatened and endangered species and assist their population recovery. The first obvious need is the ability to directly protect the species from human action. Departments also need legal authority to take positive management action alone or in cooperation with other groups. They need a basis to protect and manage habitats. Lastly, they need a way to ensure other things in the environment do not harm the threatened and endangered species.

The following discussion outlines the legislation used to manage and protect endangered species in Saskatchewan and refers to a couple of pieces of legislation which can potentially be used to support endangered species but which have not so far been used for this purpose.

The Wildlife Act is the basic piece of legislation used in managing the endangered species that I deal with. This act defines wildlife as a "vertebrate animal or bird of any species excluding fishes that is wild by nature in the province, or any exotic wildlife that has been introduced into the province, and includes any part of any such animal or bird." All wildlife is protected from hunting and killing unless the regulations specify an open hunting season. Thus, when we perceived a need to protect rattlesnakes and racers in 1988, the only legislative action necessary was a small regulatory change closing a previously open season. Although the Act does not mention endangered species, it is used to legally protect all species considered threatened or endangered in Saskatchewan. The Act is also used to control import and export, scientific collection or capture, and captivity of all wildlife including threatened and endangered species. Because the Wildlife Act does not specifically address threatened and endangered species, there cannot be a legislated provincial endangered species list. This list is instead established by the Department as policy.

The Wildlife Act allows creation of wildlife refuges and control of human activities in the refuges. This provision has been used successfully to help the recovery of the American White Pelican (*Pelecanus erythrorhynchos*). All pelican colonies were designated as wildlife refuges and human access was prohibited during the breeding season.

The Wildlife Act is not strictly a prohibitive piece of legislation. It also provides authority for the Department to enter into agreements for the conservation and management of wildlife. Further authority to take action for wildlife comes from the Parks, Recreation and Culture Act. Between the two acts, my department has the mandate to control all direct use of threatened and endangered wildlife and to undertake programs to assist such species. In addition, the legislation controls exotic wildlife and thus empowers us to control the import of species which other jurisdictions (e.g., Department of Agriculture) consider a threat.

Protection and management of habitat is a very important part of endangered species management. Our most important tool for this is the Critical Wildlife Habitat Protection Act. This legislation prevents the sale and restricts the use of designated provincial crown lands. Typically these lands continue to be used for hay or grazing but they may not be cleared, broken, or sold. The intent is to protect the wildlife values while allowing compatible agricultural uses to continue. Currently under this legislation, 1.85 million acres (747,400 ha) are protected of which 150,000 acres (60,600 ha) have been designated to protect habitat for species such as the Prairie Falcon (*Falco peregrinus*), Piping Plover (*Charadrius melodus*), and Ferruginous Hawk (*Buteo regalis*).

The Fish and Wildlife Development Fund was created by the Parks, Recreation and Culture Act. The wildlife component of the Fund acquires and manages land for wildlife. The major source of its funding comes from a portion of all hunting licence fees. Most acquisitions have been for game species, however, the Fund has leased some areas for Burrowing Owls (*Athene cunicularia*) and other areas which have value for endangered species. The Fund provides both the money and a mechanism to acquire and manage land directly for wildlife including threatened species.

Wildlife, including endangered species, may lose when we develop new industries, roads, dams, or other facilities. The impact on species may be from habitat loss or from toxic chemicals being introduced into the environment. The Department of Environment administers the Environmental Assessment Act to identify and deal with such threats. Under this legislation, the proponent of a new project which would have an effect on any unique, rare, or endangered feature of the environment including plant or animal life must conduct an environmental impact assessment. After public review of the environmental impact statement, the Minister either approves the project, denies approval to proceed, or allows it to proceed under certain conditions such as mitigation for lost habitats. While not perfect, this system greatly reduces the chance that new developments will be to the detriment of threatened species or other important environmental features.

The provincial Parks Act controls creation and operation of all provincial parks and protected areas. This protects a large area of prairie and parkland. These parks are one of the few areas where all plants as well as all wildlife are protected. While no sites have been designated specifically for threatened species, there are endangered species in parks and park zoning and management are being designed to help these species.

The Ecological Reserves Act allows creation of ecological reserves on crown land. A reserve can have a very high degree of protection because the regulation creating each area is specific. Reserves can be created to protect a specific area for endangered species; however, reserves have not yet been created for that purpose.

The Heritage Property Act is the legislation which is used to designate historic buildings as heritage sites. The Act also allows areas to be designated as Heritage sites because of their natural values. This would allow an area to be designated as Heritage property if, for example, it was habitat for an endangered plant. Municipalities may designate areas under this legislation. Private lands may also be designated. The Act, however, is not usually considered in this context and has never been used in relation to endangered species.

In summary, the authority and the major tools for management of threatened and endangered wildlife in Saskatchewan come from the Wildlife Act, the Parks, Recreation and Culture Act, and the Critical Wildlife Habitat Protection Act. The Environmental Assessment Act is important in protecting endangered species and in ensuring that additional species do not become threatened.

A BROAD DEFINITION OF THE CANADA-SASKATCHEWAN SOIL CONSERVATION PROGRAM

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INTRODUCTION

Programs for soil conservation consistent with the National Agriculture Strategy and the long-term strategies of Saskatchewan Agriculture are presented in this paper. These programs will be consistent with Saskatchewan's Integrated Environment Strategy and complement and support activities of other organizations and other agreements involved in the conservation of the province's environmental and soil resources. A Federal-Provincial Agreement is presently being negotiated which could involve expenditures as high as $54 million for soil conservation over the next 3 years.

BACKGROUND

Sustainable productivity of Saskatchewan's agricultural land base is threatened by wind and water erosion, salinity, and declining soil organic matter levels. Soil erosion by wind and water is a major concern on approximately 21.1 million acres (8.5 million ha) of the 48.6 million acres (19.6 million ha) of farmland in the province. Soil salinity reduces productivity on another 2.0 million acres (800,000 ha). Declining organic matter levels, up to 50% or more of original levels on many soils, is detrimentally affecting soil tilth, fertility, moisture-holding capability, and erosion resistance.

Many on-farm conservation and land management practices are perceived to be costly and to increase risk and uncertainty. A financial return may be visible only over or after a long period of time. Conservation practices may be neglected, particularly during periods of climatic and/or economic adversity, as farmers attempt to obtain financial security.

Social and economic development in Saskatchewan and at the national and international levels has led to an awareness of the role of the rural agricultural landscape in producing products and services other than basic agricultural commodities. This enhanced role includes the provision of wildlife habitat, recreational opportunity and preservation of environmental quality from the off-site effects of agricultural production.

Continued cultivation of fragile lands which are unsuitable for annual crop production, even with superior management practices, remains a major concern. Discouraging the cultivation of these fragile lands while encouraging alternative uses which involve permanent cover has been identified as a desirable goal.

STRATEGY

Meaningful progress in reversing the degradation of Saskatchewan's soil resources must involve changes at the farm level. Without the active and enthusiastic support and participation of producers, the program would fail. Technical advice and incentives would therefore be channelled through local soil conservation groups that directly involve producers in decision making. Governments would provide the catalyst for producers to join and work together to develop and implement solutions to their soil conservation problems. Significant support would be provided to these local organizations to fulfil this role.

PROGRAMS

The soil conservation needs of Saskatchewan would be addressed through five major areas of activity.

The first area would involve initiatives to improve the awareness and education of farmers, the public, local governments, program professionals, and other staff involved with soil conservation. This area would also provide an opportunity for significant support to soil conservation groups with particular emphasis on the emerging Saskatchewan Agriculture Development and Diversification Boards.

The second major area of activity provides for on-farm soil conservation activities. This would involve individual on-farm conservation planning activities, field-scale trials to reduce wind and water erosion and activities to reduce or reverse the degradation of soils affected by salinity and declining levels of organic matter. An emphasis would be placed on shelterbelt planting. Use of native tree species to improve local wildlife habitat in agricultural areas would be encouraged.

Land use adjustment would form the third major program component. There are large areas of fragile and marginal lands in Saskatchewan which are at significant risk of degradation when cultivated for annual crop production. In many of these areas, improved benefits from multiple land uses can be realized. These opportunities occur primarily where there is an agriculture-wildlife interaction such as in the pothole landscapes, in and around large marshes, and adjacent to parks and wildlife management areas. Steps would be taken to utilize existing programs such as crop insurance to discourage the inappropriate use of fragile lands in the long term. Conversion of fragile lands to more appropriate uses would also be encouraged through financial incentives. It should be noted that a considerable portion of the funding would be allocated through departments other than Agriculture so there is room for program development and implementation by departments such as Parks, Recreation and Culture and Environment.

Another land use adjustment program would be targeted at currently irrigated lands which have become severely saline through irrigation and natural processes. These lands are no longer suitable for continuous irrigation production nor can they be rejuvenated. Incentives would be provided to encourage the conversion of these lands to dryland and for the establishment of suitable permanent cover.

Soil inventory and monitoring is the fourth major component of the program. An augmented soil resource inventory would be continued to complete the physical description of Saskatchewan's soil resources. Support would be provided for the development of a Geographic Information System and also a system to monitor soil quality changes over time.

The final major area is the development and research component of the Agreement. Development activities would focus on adapting practical soil and water management technology that can be applied at the farm level. Research would be conducted at appropriate institutions, would expand and adapt ongoing work, and introduce new topics where needed to fully address the area of soil conservation.

THE PFRA ROLE IN MULTIPLE USE AND CONSERVATION OF NATURAL RESOURCES

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This paper reviews some of the existing Prairie Farm Rehabilitation Administration (PFRA) programs and their impact on wildlife and examines future program initiatives.

The PFRA Community Pastures encase some 2.2 million acres (890,000 ha) of land. Approximately 300,000 acres (121,000 ha) are improved tame pasture and there is over 200,000 acres (80,800 ha) of upland wildlife habitat. The remainder of the land is wetlands of various types and native grassland vegetation. The range management program carried out on these pastures provides for a 40% carry-over of grass cover. In those pastures which are mainly native grasslands, it is necessary to provide a mix of tame pasture in order to properly manage the native range. Thus, through modest development, PFRA has been able to maintain the land in much the same species composition as was found before settlement. We have, of course, replaced Bison (*Bison bison*) with domestic livestock.

In 1988, we initiated multiple resource use planning on one of our community pastures in southeast Saskatchewan as a pilot project. The management aspects will be evaluated and, if feasible, extended to other lands under PFRA administration. We also have our range management specialists carrying out some testing of rotational and restoration grazing systems.

Another of the long standing PFRA programs is that of providing farmers with seedlings for field and farmstead shelterbelts. We have found a tremendous interest in field shelterbelts for wind erosion control, especially during the last 4 to 5 years. Our demand has jumped 3 to 4 fold with approximately 2000 km being planted in 1988. Our Shelterbelt Centre at Indian Head has been promoting native species as part of the mix for field shelterbelts and it is encouraging to see more and more farmers requesting these species.

At the provincial level, both Manitoba and Saskatchewan have indicated that they wish to see a dramatic increase in field shelterbelts and that it be included in the National Soil Conservation Agreements. Highway departments are also starting to show a keen interest in planting living snowfences for snow control.

It is of interest to note the number of farmstead shelterbelts in the rural prairies. Although many of these farmsteads have been abandoned and often the buildings no longer exist, the owners have seen fit to leave the shelterbelts intact. In Saskatchewan and to some degree in Manitoba, these abandoned farmstead sites are prime habitat for deer, grouse, pheasant, and other wildlife. It has been our policy at the Shelterbelt Centre to supply material for wildlife plantings to special interest groups. We now have a wildlife biologist on staff to provide us with advice and technical support.

John Buchan described the renewed thrust of soil conservation to be brought about by the Canada-Saskatchewan Soil Accord. There is a growing awareness about both on-farm and off-farm impacts due to soil degradation. These new conservation initiatives will demonstrate and assist farmers with total crop system management. It is anticipated that this in turn will lead to extended crop rotations, a reduction in mechanical summerfallow, and better trash management. One of the services being discussed is the provision of on-farm conservation plans. Basically, these would be land use management plans which allow the producer to carry out conservation farming with full consideration of his management ability and economic goals.

One activity under the soil conservation program is the Permanent Cover Program. The objective of the program is to provide incentives to producers to take marginal cultivated land out of annual crop production and to put it into perennial cover of grass and/or trees. These lands are those most susceptible to erosion, especially by wind and water. The farmer will receive a cash payment on qualified lands provided that he converts the land to permanent cover. The level of payment depends upon the length of time the producer is willing to commit the land to permanent cover through a registered conservation caveat. One option under the Permanent Cover Program would assist groups such as municipalities and conservation organizations to purchase cultivated marginal land and convert it to an alternate use. In these situations, each proposal will be judged on its own merits and will require support from the local rural municipality. If the identified lands are eligible and the proposal is acceptable, then an agreement will be entered into to assist both in acquisition and conversion to an alternate use. It is anticipated that the Permanent Cover Program will provide for complimentary land use and opportunities for joint programming to other conservation programs such as the North American Waterfowl Management Plan.

In summary, I believe that there are opportunities for sustainable resource management which include both agriculture and wildlife production. The key is proper land and water use and the focal point to bring this about is the producer on the land. Without the support of farmers and ranchers, conservation and sustainable production will not happen. It is with this thought in mind that the new soil conservation programs are designed to be farmer driven. The stage is set and the time for action is now.

CHANGING AGRICULTURE (AND WILDLIFE) POLICIES AND PROGRAMS TO BENEFIT SOIL AND WILDLIFE CONSERVATION

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One of the single most important changes that would benefit soil and habitat conservation would be mutual recognition and cooperation by the agriculture and wildlife sectors. Attitudes towards resource conservation and land use are changing in both agriculture and wildlife camps. These changes are prerequisites to policy and program changes.

Wildlife agencies and organizations are generally more appreciative of agriculture than they used to be, reflecting a maturation of wildlife management. We in the wildlife field used to look on agriculture as wearing a black hat but now we realize that (1) agriculture is the lifeblood of the prairie economy, (2) agriculture is in a cost-price squeeze, (3) farmers must be protected from severe damage to crops caused by wildlife, (4) most farmers value wildlife, and (5) most prairie wildlife is and will be raised on privately-owned land. Historically, the attitude of the wildlife managers to agriculture could be likened to the attitude of the Camel cigarette smoker in advertising who said "I'd sooner fight than switch." Today, wildlife managers are thinking in terms of "If you can't beat 'em, join 'em."

There is also political recognition of the relationship between wildlife management and agriculture. In the fall of 1988 the Wildlife Ministers Council of Canada endorsed vigorous pursuit of coordination of agricultural and wildlife conservation programs. In so doing, the Honourable Jack Penner, Manitoba Minister of Natural Resources, was quoted as saying "Habitat preservation initiatives are most effective when they are integrated with agricultural policies beneficial to both wildlife and soil conservation."

Agriculture also appears to be maturing after 100 years on the prairies. There is a growing realization that farming may not be sustainable under current cropping practices because of the consequent organic matter loss and soil erosion. Some attention is also being paid to prairie ecology as reflected by the current suggestion that rotational grazing systems may owe some of their promise to their ability to mimic the grazing regime of Bison (*Bison bison*) under which prairie grasses evolved.

Many people in agri-business now also realize there is more to life than wheat! Wildlife utilization is recognized as having economic diversification and quality of life implications. There is political recognition of the need for agricultural conservation as well as wildlife conservation. When announcing the establishment of the Western Diversification Office, the federal government said, "The Minister of Agriculture will continue to work with his provincial colleagues and farm and food industry leaders to implement the National Agriculture Strategy; the strategy calls for measures to improve farm financial security, protection against climatic and economic, soil and water conservation."

POLICY AND PROGRAM CHANGES

The major waterfowl habitat restoration program developing in North America, the North American Waterfowl Management Plan (NAWMP), is putting a high priority on cooperation with agriculture. Dovetailing real programs with soil conservation programs is being actively planned now. (The Prairie Habitat Joint Venture of the NAWMP has now approved a $4 million Prairie Care program to be implemented in close conjunction with the National Soil Conservation Program, building on elements of the latter program.)

Private stewardship of wildlife habitat conservation is receiving much more attention on the prairies, with strong encouragement from Wildlife Habitat Canada. This approach is inherently more sympathetic to agriculture than the traditional one of buying land and eliminating agricultural use. Thus, traditional programs such as the Saskatchewan Fish and Wildlife Development Fund are becoming more willing to cooperate with overlapping agriculture programs.

I shall also presume to comment on required changes to agricultural *policies* leaving two other papers in this session to deal with possible new *programs*. My discussion will draw upon the recent Western Provinces Conference held in Winnipeg which had the theme "Policies and Institutions with an impact on soil and water conservation."

The Wheat Board quota system is probably the agricultural institution most frequently cited during discussions of prairie resource conservation. Cereal grains grown here are mostly marketed via delivery quotas based on cultivated acres. Summerfallow acreage is fully eligible for quota base but only a fraction of the forage acreage can be used, thus discouraging some good soil conservation practices. The main criticism of the quota system from a conservation viewpoint is that it has unwittingly encouraged the cultivation of native habitat, including marginal agricultural land.

Changing the acreage-based quota to a grain volume based quota is reportedly under serious consideration by the Wheat Board. Resource conservation is not the driving force behind this, however, merely a secondary contributing factor.

It has been argued that agricultural stabilization programs have had negative effects on resource conservation by creating an artificial financial environment. These programs, designed to stabilize farm income against price and yield fluctuation, generally have a much shorter history than the Canadian Wheat Board quota system. Recent examples include the Western Grains Stabilization Program, the Canada Special Grains Program, and drought programs. Where the production of a particular commodity (i.e., wheat) is subsidized, the lowered cost of production can influence land use decisions, such as permitting the relatively inefficient use of marginal land to produce it.

Pressure for change to these stabilization policies is coming from several directions, notably the Free Trade Agreement which looks very critically upon the subsidization of individual *commodities*. Taxpayers and conservationists are adding their voice to the call for overhaul of these sometimes expensive and conservation unfriendly programs.

Crop insurance programs operating throughout the Prairie Provinces are *yield* stabilization programs that still have some conservation-negative features. This does not necessarily have to be so. Higher coverage for summerfallow crops and premium subsidization for high risk areas are examples of conservation-negative features. There is broad recognition of some of these problems associated with crop insurance however, as exemplified by recent statements by the Premier of Saskatchewan. The Western Provinces Conference in Winnipeg last December also recommended changes to existing programs to make them "conservation friendly" or at least neutral in their effect.

Finally, something as basic as the land taxation system is believed to detract from the conservation of marginal agricultural land and native wildlife habitat. Farmers do not like paying taxes any more than anybody else and when they perceive they are paying taxes more or less equally on all parts of their holding, they are inclined to intensify use of the non-productive parts. While they actually pay very little tax on the non-cultivated areas that are so important to wildlife, this is not widely understood. Tax *credits* for native lands, offered by higher levels of government, would be a way to magnify the potentially positive influence of the tax structure on wildlife habitat conservation.

SUMMARY

There *is* an important convergence of conservation concern by agriculture and wildlife interest groups. This will be very conducive to the development of effective, coordinated conservation efforts including the reform of existing policies and programs and the development of new ones. Change will be slow however, and non-conservation levers will remain the most powerful influence on agriculture. Conservation arguments can help to tip the balance, especially if the current public environmental concern comes to bear on the issue.

LAND MANAGEMENT FOR WILDLIFE AND AGRICULTURE - DISCUSSION AND CHAIRMAN'S COMMENTS

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The session was designed to look at the interface between agriculture and wildlife and ideas for action which could further conservation of biological diversity. The session focused on possible changes to existing policies and programs which would have soil and wildlife conservation benefits and new soil conservation initiatives.

The discussions did not succeed in reaching consensus on specific actions, although there was consensus on the main idea that maintaining biological diversity on the prairie is highly dependent on actions of agricultural agencies. In addition, the following points arose during the discussion.

(1) Wildlife interests, although they are now being heard more at a national level through the efforts of groups like Wildlife Habitat Canada, should be represented on key prairie policy making bodies such as the Canadian Wheat Board.

(2) The soil conservation programs which were discussed reward the person who has contributed to soil degradation by paying him to repair the damage but do not seem to reward the person who has managed soil responsibly all along. There should also be some incentive for the person who has retained native prairie.

(3) As in all communities, peer recognition is important in the agricultural community. A key to promoting land conservation on the farm will be peer recognition that it is the right way to do things.

(4) A public awareness program on the values of native areas could help change people's perception. A theme like "Save our Aspen!" was suggested.

(5) Native species should be used in permanent cover programs. However, it was noted that the supply of seed will severely limit the use of native species.

(6) Mr. Buchan noted that aspen used to be fostered because of its value for firewood. Once that value disappeared, the aspen bluffs began to disappear. New uses of aspen such as pulp aided by Saskatchewan's Private Woodlot program may help keep some parts of farms in tree cover.

(7) Rural Municipalities are too small and too unwilling to regulate people who are neighbors. Perhaps larger conservation districts are needed. This is being examined for the soil conservation program. In Manitoba, conservation districts are organized by watershed but they have no regulatory power.

(8) P.F.R.A. can manage for endangered species on their pastures but Mr. Chambers pointed out that the pastures have to be managed for cattle too. Endangered species management on a pasture will be a problem if it is a significant departure from good cattle management.

BALANCED LAND USE - AGRICULTURE AND WILDLIFE

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Historically, the great plains of North America which encompasses the southern portions of the Prairie Provinces was one of the most diverse and productive ecosystems in the world. The lush grasslands, rich wetlands, and unique aspen parklands teamed with an abundance and variety of wildlife. The devastating destruction brought about by uncontrolled market hunting brought many species to the brink of extinction while actually sending some such as the Passenger Pigeon (*Ectopistes migratorius*), Plains Grizzly Bear (*Ursus arctos*), and Buffalo Wolf (*Canis lupus*) into oblivion. The Migratory Birds Convention Act of 1916 along with controlled hunting of certain wildlife species rescued many species from certain extinction. Throughout the 1900s, species management has resulted in animals such as Pronghorn Antelope (*Antilocapra americana*), Mountain Bluebirds (*Sialia currucoides*) and raptors making a remarkable recovery. However, an unnoticed threat, the loss of habitat, has slowly been taking its toll on our native plants and animals for decades. It was not until the early 1970s that the word "environment" became known to most of us. It was becoming evident that it just was not enough to protect species of wildlife; we had to protect their habitat. Without habitat, there is no wildlife.

The same productive soils which once supported a rich sea of grass now supports one of the most intensely farmed areas in the world. When the first settlers began turning the prairie sod with oxen and ploughs, it no doubt seemed that there would always be vast areas of this untamed land. But from the outset, the first settlers were compelled by government policies to conquer the land. Land was provided free to the newcomers provided they broke so many acres a year. Records of government promoting drainage of wetlands dates back to at least 1915. The drought of the 1930s dealt a devastating blow to many of the pioneers who toiled long and hard to scrape out a living from the harsh land. Many homesteads were abandoned as families packed up their belongings and moved elsewhere seeking out a living.

The drought also impacted many species of wildlife such as waterfowl. Undoubtedly, millions of creatures perished from the hot and dry weather, which caused vast numbers of vital wetlands to disappear. However, unlike man-made inflictions on wetlands, the wetlands affected by the drought of the 1930s would return with the snow and rain. With adequate habitat, wildlife populations would rebound quickly with favorable weather conditions. Following World War II, a new generation was ready to return to the prairies and make a living from the land like their parents before them. During the war years, great advances in technology changed the ways on Canadian farms. Rubber-tired tractors replaced horses. Combines and grain augers and other machinery unheard of 20 years ago were now available to greatly reduce the work load on the farm. With the future of farming much more attractive and the ability of individual farmers, through technology, to work more and more land, there was ever increasing pressure to clear, drain, and break more and more land.

During the 1960s, the slow but continued disappearance of wildlife habitat on the prairies really became noticeable. For example, Saskatchewan's spring duck population in the 1950s was around 20 million birds and White-tailed Deer (*Odocoileus virginianus*) numbered about 500,000 animals. The 1960s and 1970s saw all forms of wildlife habitat decimated. Grasslands were ploughed, wetlands drained, and aspen parkland cleared. Government-sponsored programs and subsidies encouraged ploughing, draining, and clearing. In Saskatchewan alone from 1976 to 1981, nearly two million acres of habitat were lost. Broken down, this works out to over a thousand acres a day or 44 acres an hour, day and night. Even in the 1980s with suppressed markets, drought, and many farm bankruptcies, the loss of wildlife habitat continues. In 30 short years, we have witnessed an 80% decline in our duck populations with fewer than 4 million birds now returning to Saskatchewan. The White-tailed Deer population has declined by over 50% to fewer than 240,000 animals.

In a mere 100 years in the Prairie Provinces, 40% of wetlands, 75% of the aspen parkland and mixed grass prairie, 90% of fescue grasslands, and over 99% of tall-grass prairie have been lost. In all, about 80% of the native prairie landscape has been transformed by agriculture and to a lesser degree urbanization and industrialization.

Looking back over the past three decades we see great changes have occurred within rural society. The number of farmers have declined by over 30%. The number of mixed farms, livestock and grain operations, are only a fraction of what they were 30 years ago. Around 1980, the average age of a farmer was 55. Very few farmers were employed off the farm thirty years ago; today a majority of farm couples have one or both partners earning income off the farm. Thirty years ago most prairie farmers resided on their farm. They pastured cows on marginal land such as hillsides, harvested hay from the natural wetlands, obtained their wood supply for their homes from the aspen groves. As smaller farms were taken over by larger operations, there was no need to maintain the pasture land, slough bottoms, or woodlots. Thus, the small holdings were often cleared, drained, and broken from one side to the other. As more and more farmers resided in nearby towns or spent the winter months in warmer climates, less and less time was actually spent on the land. Large equipment and thousands of acres to work does not provide the same contact with nature as was provided to the smaller farmer who worked at projects such as fixing fences and cutting firewood. Today technology and economic incentives are such that a progressive farmer is often viewed as one who cultivates every acre of land on his farm.

The impact of the agriculture industry on the Canadian prairies has been devastating to our native flora and fauna. Conservationists and wildlife managers alike are confronted with unprecedented challenges as we examine ways and means to conserve remnant natural habitats on private land.

As we attempt to examine the balance of land use between agriculture and wildlife, we need to look at the pros and cons for landowners who retain habitat on their land. There are many reasons for landowners to convert natural habitat to cultivated land. (1) Many farmers derive no direct economic benefits from acres of land remaining in natural habitat. (2) Wetlands, clumps of trees, and other remnants of habitat are inconvenient and cost money to work around. (3) Natural habitat may harbor wildlife such as waterfowl and grasshoppers that consume or destroy farmers crops. (4) Costs incurred in bringing natural habitat under cultivation can be used as a tax write-off. (5) It often costs less to bring natural habitat under cultivation than it does to purchase additional cultivated land. (6) Government subsidies are still available for drainage of wetlands on private land. (7) Landowners have to pay taxes on land containing natural habitat. (8) The sale of grain through the Canadian Wheat Board is based on cultivated acres rather than farm size. By clearing and breaking habitat, more cultivated acres can be added to the producer's permit book. (9) Crop insurance programs, which guarantee a minimal production on marginal lands, encourages the cultivation of areas such as sand and lands vulnerable to erosion which would be best left in natural habitat. (10) The image of a progressive farmer is based on wide open fields with no "wasteland." (11) Natural habitat often attracts people whether they be hunters, berry pickers, or hikers. Some of these visitors do not respect the landowners' rights and this results in poor public relations and headaches for the landowner. (12) In the past, landowners have received little, if any, recognition for their efforts in preserving habitat on their land.

The reasons for landowners retaining habitat on their land are not nearly as numerous as the reasons for destroying habitat. (1) Much of the remaining habitat is located on marginal lands such as hill sides and sloughs; little income would be derived by trying to farm such areas. (2) The high cost to bring new land under cultivation discourages some landowners from breaking, clearing, and draining natural habitat. (3) Maintaining natural cover in the form of trees, grass-covered hills, and sloughs reduces soil erosion by wind and water. (4) Maintaining natural habitat provides a place for wildlife to live and, in turn, landowners can observe and appreciate wildlife. This is important to many landowners who take pride in having wildlife on their land. (5) Wildlife provides recreational opportunities such as bird watching, feeding wildlife, and hunting for the landowner. Basically, economics and to a larger extent the landowner's personal interest and commitment to preserving wildlife habitat are the two main factors determining whether or not wildlife habitat remains on private land.

We need to ask ourselves what the public can do to encourage and assist landowners in preserving wildlife habitat on their land. The following are a few suggestions:

(1) Recognize landowners for their efforts in maintaining habitat on their land. A little bit of praise or recognition goes a long way.

(2) Lobby governments to change policies that encourage and promote the destruction of habitat on private land (e.g., grain quotas, marketing systems, and government-subsidized drainage programs).

(3) Respect landowner rights. Obtain permission to go on private property whether for the purpose of hunting, nature photography, berry picking, or bird watching.

(4) It may be possible to work with landowners in enhancing their property for wildlife by providing nest boxes for birds, planting trees, etc.

(5) Many landowners have a treasured piece of natural habitat that they want preserved for wildlife. Wildlife groups can assist such landowners by purchasing or accepting such property as a donation and conserving it in a natural state in perpetuity.

(6) It may be feasible in some cases to pay the landowner a small annual lease fee to protect certain habitat areas. In Saskatchewan, the "Operation Burrowing Owl Program" is an example of this type of incentive. Landowners with more than five pairs of nesting Burrowing Owls (*Athene cunicularia*) are offered a few hundred dollars to maintain the Burrowing Owl habitat. The Burrowing Owl situation is unique in that there are only a dozen or so such nesting colonies and their habitat consists of flat grassland which can easily be converted to cultivated farmland.

A PROJECT FOR RETAINING AND ENHANCING CRITICAL WILDLIFE HABITAT ON PRIVATE LANDS IN SOUTHERN ALBERTA IRRIGATION DISTRICTS

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Several published accounts are available that discuss the rapid decline of critical wildlife habitat on private lands due to agricultural land developments, including clearing and draining. Since the majority of agricultural land in Alberta is privately owned, a need for a cooperative resource management approach is apparent. This need was magnified in the Southern Region by the instigation of a multi-million dollar Irrigation Rehabilitation program that threatened to create significant loss of existing wildlife habitat. This projected loss prompted the Government of Alberta, Fish and Wildlife Division, and Wildlife Habitat Canada in June 1986 to embark on a 3-year pilot project within two Irrigation Districts to determine effective means of retaining and improving potential and existing critical wildlife habitat on private land. The project was called the Landowner Habitat Project.

HISTORY OF HABITAT LOSS

In the early 1900s, irrigation became a permanent fixture of the land with remarkable results. In the Eastern Irrigation District alone, 1200 miles (1930 km) of delivery canals contributed thousands of acres of wildlife habitat. High production of a variety of agricultural crops became a reality and oases of trees, shrubs, and grass were created wherever there was seepage from the canals. Several species of wildlife adapted so well to these seepage areas and to adjacent irrigable and non-irrigable land that their survival in any given year was dependent on these areas. These areas are critical wildlife habitats, particularly for pheasant, waterfowl, and deer.

Unfortunately, over the years, many of the critical habitats have been lost as a result of a number of things including irrigation rehabilitation projects. The objectives of irrigation rehabilitation were clearly to reduce the seepage loss and subsequent salinity by lining canals and other methods. Such procedures improve water efficiency by reducing water loss but eliminate water needed to maintain critical vegetation components of wildlife habitat, mainly nesting and winter cover.

Recent studies by the Alberta Fish and Wildlife Division showed losses of critical habitats after a 5-year period (1978-1983) of 20 to 76% depending on the irrigation district involved. Forty-four to 96% of these habitats were on private land.

PROJECT OPERATION

The Bow River Irrigation District (BRID) and the Eastern Irrigation District (EID) were chosen as the study areas because 80% of the remaining pheasant and waterfowl habitat are within these two districts; they have cooperated in the past and they have an active canal rehabilitation program.

A prime objective of the project was to develop acceptable economic incentives through direct payment or payment in kind to the landowner in return for maintaining and enhancing critical habitat on his or her land.

Level of payments were determined by an opportunity cost analysis of typical farm operations in the two irrigation districts. The opportunity cost represented the landowner's financial loss for retaining critical wildlife habitat rather than reclaiming and farming it. In many instances, this loss approximated custom lease rate payments. Therefore, lease rates were used as the standard form of payment. Payments varied according to the extent of compatible agricultural use of the wildlife habitat.

Those critical habitats in danger of removal through irrigation rehabilitation programs help in determining the order in which landowners are approached. The process of acquiring landowner cooperation involved discussions of the farm operations in so far as they affect existing or potential critical habitat and discussion of ways to maintain and improve the critical habitat. Such practices as rotational and deferred grazing, limited tilling, fencing, and delayed haying help in improving vegetative cover for pheasant, waterfowl, deer, and a host of other game and non-game species. Also, farms suffering from erosion and overgrazing can often benefit from such practices. A delay in haying by just one week can result in increasing pheasant production by 30 to 40%. Although some hay quality is sacrificed for quantity, many farmers feel they can cut later providing they are financially compensated for the delay and the area involved is not too large.

Length of agreements vary from 5 to 20 years and more. There are also possibilities of agreements of a more permanent nature such as restrictive covenants and easements. The agreement, once signed by the landowner, is then endorsed by the irrigation district in which the critical habitat exists. This endorsement assures that canal access and a water source are available to the Alberta Fish and Wildlife Division for maintenance and improvement of the critical wildlife habitat. Water for the critical habitat is used only when not required by the landowner for crop production. At no time is water provided to the critical habitats when it is needed by the water users for their farm operations.

With the endorsement completed, the Fish and Wildlife Division and the landowner agree to a location for the erection of an attractive sign that acknowledges the landowner and irrigation district "cooperation and participation in the enhancement and management of habitat for Alberta's Fish and Wildlife Resources." The landowner still has sole right to control access and may find that the sign helps in reducing trespass violations.

PROJECT RESULTS

The response of landowners to the program has been excellent; most farmers approached are willing to cooperate to maintain some of their wildlife habitat. The key ingredients for success of this project are (1) an interest in maintaining wildlife, (2) economic incentives to complement the changes requested in the farm operation, (3) cooperation of the irrigation districts in allowing access and supplying water when available and (4) support from various branches of Alberta Agriculture and the private sector in the form of advice for formulating incentive payments and classifying land where the critical habitat is located.

Agreements are sought from landowners only where the maintenance and improvement of the critical habitat will not seriously conflict with the objectives of an irrigation rehabilitation project. There is a misunderstanding among some landowners who feel a conflict of interest exists, namely, one department removing seepage areas while another one seeks to re-establish them. On the contrary, the program is a cooperative venture whereby the loss of water through seepage is now utilized to maintain critical wildlife habitat. Measured amounts of water are now supplied by the district to maintain this critical wildlife habitat but only when not required by the water users. Maintenance of critical habitat through water application must not contribute to salinity problems on land adjacent to the habitat.

SUMMARY

The Landowner Habitat Project is just a beginning towards assuring that wildlife is a part of the private landscape. As long as the landowner appreciates wildlife and receives reasonable compensation for changes in his or her operation to accommodate wildlife, there will be a future for the wildlife resource on private property. The public must, however, be willing to pay the landowner a fair price to retain critical wildlife habitat.

Further project recommendations are:

(1) the project needs to be expanded on private land, province wide and in the Southern Region, particularly in the 11 remaining Irrigation Districts,

(2) a continuing effective public relations program is needed to assure a respectful use of private land by consumptive and nonconsumptive users,

(3) a more accurate account of the costs and benefits to the public of retaining and enhancing wildlife habitat is needed to ensure that our incentives to landowners remain equitable, and

(4) a parallel course of legislative changes should occur to insure that national and provincial land use policies reflect cooperative resource management of private land.

BALANCED LAND USE ON PRIVATE LANDS

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One of the objectives of the Red Deer River Naturalist Society, the oldest and one of the most active naturalist groups in Alberta, is to "support conservation measures dealing with the environment, wildlife and natural resources." To this end, we involve ourselves - to the degree that our volunteer resources and limited budget allow - in global, national, regional, and local issues. It is our participation in local, grassroots programs involving the conservation of wildlife habitat on private lands that will be discussed in this paper.

In Alberta, incentives for conserving wildlife habitat on private lands are provided by a few non-governmental groups and only one provincial government department, the Alberta Fish and Wildlife Division of the Department of Forestry, Lands and Wildlife. Government programs involve the provision of funds for habitat "enhancement" projects and payments to qualified landowners who agree to take their land out of agricultural production in order to maximize its wildlife habitat potential. Of special concern to the Red Deer River Naturalists is that some provincial departments still adhere to a "rob Peter to pay Paul" principle. For example, a farmer who qualifies for the Alberta Fish and Wildlife Division's "Landowner Habitat Project" can also go to the Department of the Environment and apply for funding assistance to drain wetland areas on another portion of his/her farm. If approved, the taxpayer picks up 86% of the tab.

The Red Deer River Naturalists (RDRN) continue to urge the Department of the Environment to re-examine this questionable policy. In the meantime, we have tried, as a volunteer group, to encourage wildlife habitat conservation on private lands through our own programs.

HABITAT STEWARD PROGRAM

We launched our "Habitat Steward" Program in 1987 as a Wildlife '87 project. Inspiration for the program came from Lorne Scott, who addressed one of our meetings in the fall of 1986. The Habitat Steward Program is loosely based on the Alberta Fish and Game Association's program by the same name, although the RDRN program recognizes the value of all habitat, not just that which supports game species.

Since many RDRN members are farmers, we have long been aware that habitat conservation is a concern to at least some farmers and that many do make a concerted effort to conserve pockets of wildlife habitat on their land. The RDRN feels that the recognition of these efforts is long overdue.

As an organization strong on enthusiasm but short on surplus funds, we approached Alberta Government Telephones for funding support. They very generously provided us with the funds to purchase 100 large, baked-enamel "Habitat Steward" gate signs.

Since the main objective of this program is to provide recognition to farmers who, on their own initiative and at their own expense, conserve wildlife habitat, the guidelines for participation have been kept to a minimum: each participant must maintain at least 2 ha of habitat for wildlife and the sign must be returned if the landowner destroys the habitat value of the designated land.

To date, 58 landowners have joined the program. This represents about 2850 ha of aspen parkland, forests, wetlands, and riparian habitats that central Alberta farmers have protected for Alberta's wildlife. We are confident that we will have another 35 participants and several thousand more hectares signed up by the end of 1989. If the program were to be expanded to a provincial level, participation would no doubt increase several-fold.

We believe that programs such as the Habitat Steward Program, if advertised and administered effectively, could provide both widespread recognition and an incentive for landowners to conserve wildlife habitat.

BACKYARDS FOR WILDLIFE PROGRAM

The "Backyards For Wildlife" Program, also launched in 1987, is a cooperative project of the RDRN and the Kerry Wood Nature Centre. The target groups for this program are acreage and urban landowners.

This program was launched with the production of a small booklet entitled "Backyards for Wildlife." Several hundred copies have now been sold through our newsletter and the Kerry Wood Nature Centre. The second phase of the program was the establishment of a "certification" program whereby people who have set up a backyard designed to attract wildlife receive a certificate designating them with an "official" backyard wildlife habitat.

We were recently advised that the Federation of Alberta Naturalists hopes to extend this program across the three prairie provinces.

PRIVATE CONSERVANCY LEASE

In the summer of 1987, the RDRN signed a 10-year "Private Conservancy Lease" with a farmer near Lacombe for 8 ha of rare wetland habitat. Containing a dozen species of orchids and the rare sundew, *Drosera anglica*, this area is now protected under the stewardship of the RDRN. To maintain the long-term integrity of the site, its location has not been publicly disclosed and it is inspected by an RDRN member only once a year.

CONCLUSION

The Red Deer River Naturalists are also examining other strategies for encouraging the conservation of wildlife habitat on private lands in central Alberta. One idea that we feel has merit is the establishment of a regional "Habitat Trust" that could acquire lands, either through purchase or bequeathment, for wildlife habitat. We are also examining the feasibility of becoming stewards of property that may be leased from a local farmer through the Natural Areas Program of the Public Lands Division, Alberta Forestry, Lands and Wildlife.

Though obviously limited by funds and the energy levels of our volunteers, the RDRN remains committed to promoting, on a grassroots level, the conservation of habitat on private lands. We would be very interested in sharing ideas, knowledge, and experiences with other groups in this regard.

EMERALD THREADS

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Editors' Note: The following text summarizes the slide talk presented at the Workshop's banquet and is based on notes provided by the speaker.

The powerful force of flowing water has for eons been the prime agent in the sculpting and reshaping of the earth's surface. As the Ice Ages came and went, the northern rivers vanished and reappeared; sometimes they occupied their old pathways but often they carved new channels. At the end of the last Ice Age, vast amounts of melt water cut deeply into the landscape creating the foundation for the distinctive network of valleys which today wind their way across the arid plains. The abandoned terraces along the broad valleys show that most modern streams are mere trickles compared to their former size but they are still at work eroding, transporting, and depositing materials. These processes maintain the patterns of landforms and vegetation which characterize each valley bottom. Along some sections, there is a very small active floodplain and little development of riparian habitats. This can occur when rivers are confined by bedrock along valley sides or where a steep gradient causes rivers to flow more swiftly and directly. Broader valleys, with slower flowing waters, sustain meandering rivers; their extensive flood plains support diverse shrubbery and woodlands. River channels constantly change their course; abandoned channels or oxbow lakes may be formed as the channels shift or cut through meander loops. The deposition of new sediments and the erosion of others is a balanced process along meandering streams. The fast-flowing water on the outside of meanders cuts into old sediment deposits, often removing mature woodland, while sediment carried in slow-moving water on the inside settles out creating new sand and gravel point bars. These point bars, if kept moist for several weeks in the spring, are ideal sites for the rapid, dense growth of willow and cottonwood seedlings. In time, the point bar communities mature and become a diverse mosaic of shrubbery, meadow, and woodland.

This dynamic environment is very easily upset. The renewal of riparian habitats may be prevented if dams reduce the amount of stream sediment or greatly affect the flood portion of the annual flow cycle. Also, new growth of cottonwoods can be completely destroyed by heavy grazing by cattle. Because of man's activities, riparian habitats are some of the most threatened ecological systems in the world.

Although several major rivers wind through the vast expanse of the prairies, their area is equivalent to less than 1% of the entire grassland region. Luxuriant shrubbery and woodlands abound with a remarkable variety of breeding birds. Three-quarters of the bird species that breed in the grassland region use riparian habitats for feeding or nesting. These corridors of greenery are also essential to songbirds migrating between northern forests and southern wintering ranges. Other riparian habitats such as open water, shorelines, and eroding cutbanks are important to wildlife as they provide nesting and feeding sites. Steep bedrock slopes provide nesting places for eagles, hawks, and falcons. Oxbow lakes and abandoned channels are rich in aquatic life and are especially important for reptiles and amphibians. The profusion of animal tracks along shorelines gives only a hint of the productivity in these restricted bottomlands. Valley habitats are not separate from the surrounding grasslands; some animals move freely between the uplands and valleys. The Pronghorn (*Antilocapra americana*), for example, seeks shelter in the bottomlands during harsh winter conditions. River valleys are also often the only sanctuaries in a landscape that is greatly altered by man.

There are also features, uninfluenced by the modern river channels, which add to the complexity of the valley systems. Alkaline springs emanate from dry slopes and form wet, green meadows that teem with insect life. Eerie badland formations have been sculpted out of sediments that were laid down during the Age of the Dinosaurs millions of years ago. Deep coulees combine with main valleys and sweeping horizons to create the majestic scenery which characterizes the Great Plains.

The value of the river valleys is only now being realized. Wise management of entire river basins and protection of their most significant reaches are needed to maintain the variety of riparian habitats. The very existence of these emerald threads is tied to the ever changing natural flow of waters to the sea. Ultimately, their fate rests in the hands of man.

PHENOLOGY: THE POTENTIAL FOR EDUCATION

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INTRODUCTION

Phenology, the observation of life cycle phases in plants and animals in their environment throughout the year, has great potential for raising awareness of prairie environments. In other parts of the world, phenology has a long history. Observations began thousands of years ago in the Orient and volunteer networks have now provided over two centuries of development dates for plants for much of Europe. In Alberta, a survey revitalized in 1987 involves 15 native wildflowers and is recruiting a growing number of observers. Flowering dates are mapped to illustrate the "green wave of spring." As dates from more years are analysed, survey results will show how parts of Alberta differ phenologically and will assist decision-making in fields such as agriculture, forestry, climate studies, remote sensing, and human health.

School children involved in phenology studies become "the eyes of science." Their ecological awareness grows through frequent observations of the interactions of weather, plants, and insects. As their interest in native species grows, so will their concern for stewardship of native habitat.

WHAT IS PHENOLOGY?

Phenology comes from the Greek "*phaino*" meaning to show or to appear. This "science of appearances" is defined as the study of the seasonal timing of life cycle events (Rathcke and Lacey 1985). Examples of these events (phenophases) in plants include leaf unfolding, first flowering, and full flowering and in animals include bird nesting and bird or mammal migration.

Plants are the most common focus of phenology studies. They act as natural weather instruments, reflecting the influences of local climate in their development. The main environmental cue for flowering seems to be temperature. "Most temperate woody species and some perennial herbs flower in response to temperature, which usually acts through cumulative heatsums above some threshold level" (Rathcke and Lacey 1985:190). In other words, these plants will flower after they have been exposed to a certain amount of heat.

Once a good understanding of the phenological development in an area is reached, the benefits are numerous. Phenology observations should be collected in an area for at least 10 years to provide an accurate estimate of the average dates for an event such as Saskatoon (*Amelanchier alnifolia*) flowering. By comparing flowering times in subsequent springs to the average, these springs can be seen to be early, average, or late. This information can help ensure the best time for activities as diverse as planting seeds, moving bee colonies, or planning vacations to avoid mosquito outbreaks or hayfever pollens. While the timing of a phenophase (e.g., flowering) in one plant can be an indicator of when a subsequent stage will occur in that plant (e.g., ripe fruit), it can also provide accurate predictions of when other plants, or insects, will develop. For example, timing of lilac flowering is used to predict when apple trees will flower (Gilroy and Hopp 1978) or when insect pests such as alfalfa weevils will appear (Caprio 1966). The ability to predict that is provided by phenology crosses trophic levels and can assist us in knowing when to expect phases in insect, fungal, and vertebrate life cycles.

PHENOLOGY PAST AND PRESENT

Phenology is an ancient fascination. Thousands of years ago, in both China and Rome, agricultural calendars were made using phenophases such as blooming of cherry trees. The father of modern phenology is Carolus Linnaeus, the Swedish botanist who also gave science the naming system used for all organisms. He described how to compile an annual calendar using leaf opening, flowering, fruiting, and leaf fall as well as weather records to discover how areas were different (Linnaeus 1751). Observations have continued over the years and networks of volunteer observers are presently collecting data on both native and cultivated plants in most European countries (Hopp 1974). Meteorological departments generally coordinate the networks and use the information to assist agriculture.

For the native people of the Americas, phenology was basic common sense. The Blackfoot Indians in Alberta used the flowering time of Golden Bean (Buffalo Bean), *Thermopsis rhombifolia*, to indicate the brief period when the Bison (***Bison bison***) bulls were prime for the spring hunt (Johnson 1987). These native people were very knowledgeable about native plants and phenology.

In 1973, Dr. Charles Bird, a botanist at the University of Calgary and an active naturalist, started a 10-year phenology survey through the Federation of Alberta Naturalists. For the first few years, he requested blooming dates for 100 species of Alberta wildflowers. He then reduced the number of species observed to 12 "key phenology species." These plants were all easy to recognize, had a brief and consistent flowering period and were relatively widespread across the province. The flowering dates for locations around Alberta were published annually in the spring issues of the "Alberta Naturalist" (Bird 1974-1983).

PHENOLOGY SURVEY OF ALBERTA

In 1987, as part of a Master of Science degree in botany under the supervision of Dr. Walter Moser, I revitalized Dr. Bird's Alberta survey. Three wildflower species were added to the survey to make a total of 15. An observer network was recruited through the media and through government and non-government organizations. Presently the survey has about 200 observers including farmers, ranchers, home-makers, volunteer weather observers, fire-tower staff, travelling salesmen, naturalists, biologists, students, and many retired people. Recruitment of volunteers was greatly assisted by distribution of the booklet "Alberta Wildflowers" which I published in the spring of 1988. Information in the booklet includes color photos, descriptions, and ethnobotany of the 15 wildflowers as well as instructions on observing the flowering stages. Observers are asked to select relatively flat areas for observation to minimize the effects of slope and aspect on flowering. They then record, on an enclosed data sheet, the dates when each species reaches 10, 50, and 90% flowering. The data sheets are returned by observers at the end of the season. The approximately 4000 flowering dates received for 1987 and 1988 have been entered into a computer database and the data have been analyzed. Average dates by area have been mapped to chart the green wave of spring across the province.

The following are the native plants species chosen for the survey, in their usual order of flowering. Many of these plants are found across the prairies and would be useful for phenology studies in Saskatchewan and Manitoba as well as Alberta.

Anemone patens	Prairie Crocus
Populus tremuloides	Aspen Poplar
Viola adunca	Early Blue Violet
Thermopsis rhombifolia	Golden Bean
Amelanchier alnifolia	Saskatoon
Smilacina stellata	Star-flowered Solomon's-seal
Prunus virginiana	Choke Cherry
Lathyrus ochroleucus	Vetchling
Elaeagnus commutata	Wolf-willow
Galium boreale	Northern Bedstraw
Linnaea borealis	Twinflower
Achillea millefolium	Common Yarrow
Lilium philadelphicum	Western Wood Lily
Gaillardia aristata	Brown-eyed Susan
Epilobium angustifolium	Fireweed

APPLICATIONS OF PHENOLOGY

There are many potential uses for phenology data. The following are some of the fields which could benefit.

Agriculture: Phenology provides predictions of optimal times for planting, fertilizer application, pest control, and harvest. For grazing cattle, Budd and Campbell (1959) suggest that permanent pasture is ready when the Wild Rose (*Rosa woodsii*) begins to flower, which is generally 50 to 55 days after Prairie Crocus appears. In Montana, Caprio (1966) determined that alfalfa is usually ready for its first cutting 30 days after the lilac starts to flower.

Horticulture: In a given spring, early or late, local phenology will indicate the best time in spring to plant vegetables and flowers.

Tourism: Knowledge of local flowering sequences and the timing of peak wildflower bloom helps plan park and community programs for the public.

Recreation: Once the growing season is underway, wilderness trips can be planned to avoid biting insects or to maximize fly-fishing success by predicting the timing of the hatch of aquatic insects.

Climate studies (phenology provides a baseline for future comparisons), forestry, entomology, medicine (pollen warnings for hay-fever sufferers), and remote sensing are all fields which can use phenology information.

PHENOLOGY - THE POTENTIAL FOR ENVIRONMENTAL EDUCATION

Adult Education

Phenology is an invaluable tool waiting to be used. It can help us raise the ecological consciousness of both adults and youth. By observing plants over the growing season, people gain an interest in and understanding of the interplay of plant growth, weather, and insects. As well, observers become aware of where these native plants occur - where there are still pockets of native vegetation in our agricultural landscape. Environmental awareness will lead to stewardship of these endangered spaces.

As the stresses of resource consumption and population growth increase on the prairies, environmental education becomes even more important. We need to create an ecological conscience in the human masses.

Presently, the observer network for the Alberta survey is largely composed of adults. Many of these have indicated in their correspondence that they have greatly enjoyed learning about wildflowers through participating in the survey. A growing number of Albertans will be recruited as observers in the years ahead.

Student Networks

Examples of the advantages of phenology for education are available from Canada and abroad. As far back as the 1890s, the education system in Nova Scotia (encouraged by the Royal Society of Canada) enthusiastically took up phenology. By 1898, 800 sets of observations were being submitted annually by classes across the province (MacKay 1899). As part of the Nature Study curriculum, students observed up to 100 events including the arrival of the first robin in spring, the break-up of ice on rivers, and the first bloom on many plants. Students who first noted an event for that year had their names placed on the honor roll section of the blackboard for the day (MacKay 1927). The benefits were obvious:

> "Inspectors report it as being the most valuable stimulus yet given to direct teachers and pupils to the active study of nature - to the elements of the natural sciences underlying the industrial development of the country. It also tends to develop the habit of accurate observation, as necessary to a successful literary or professional career as to the industrial occupations" (MacKay 1899).

Almost a century later as we seek ways to cope with the environmental consequences of our "industrial development," phenology has even greater relevance.

In Europe, students are presently contributing data to phenology networks. School classes in Germany are involved in collecting data on the timing of growth and flowering of crops and native plants for the national weather bureau's phenology survey. These observations form part of their studies in biology and ecology. The data they gather are used for monthly reports which benefit agriculture and crop protection (Hopp 1974). This centuries-old interest in phenology has helped to produce a European population that is more knowledgeable about and interested in native plants than are modern North Americans.

Benefits for Education

Today, the advantages of phenology for teachers and learning are considerable:

(1) The focus of learning is moved outside the classroom. Observations can be done while walking to and from school in rural areas or in city parks.

(2) Plants are easy subjects to observe. Unlike deer or birds, they do not run away!

(3) Children enjoy observing changes and watching their list of observations grow.

(4) Phenology provides opportunities to practise the skills of observing, describing, recording, and making hypotheses. For example, if the average date of Prairie Crocus flowering is April 20th and a heavy snowstorm descends April 17th, what will happen to the flowering time?

(5) Children are given an opportunity to be the "eyes of science."

Benefits for the Environment

(1) Phenology observations are invaluable baseline data in monitoring future climate change.

(2) A respect for nature is promoted. As Stearns (1974) noted in his article on phenology and education: "it would be a traumatic event for the entire third grade class if some vandal destroyed the tree whose buds they were watching."

(3) These children are future legislators. Phenology is an excellent way to raise their ecological awareness early, by observing the interactions of weather, plants, and insects.

(4) "The Canadian prairies, grassland, and parkland, have been so radically transformed by human activity that they have become one of the most endangered natural regions in Canada" (World Wildlife Fund Canada 1988). Appreciation for our disappearing native flora is needed as soon as possible!

The Future

Many challenges lie ahead. In Alberta, the phenology survey must be marketed to our education department for incorporation into the school curriculum. To start, a teacher's manual could be developed for the Grade 5 level. Examples of how to use flowering dates from around Alberta in maps and graphs would be included. One exciting data collection method would be via a "kid's network," similar to the computer network started in 1988 through the National Geographic Society to collect acid rain information. Students send data by computer to a central scientist who returns verified dates to the classes for mapping and graphing. Dates can also be fed into an instant crop-yield and pest-prediction system once those correlations are developed. Future adaptation of the survey to the education curriculum involves many exciting possibilities!

Phenology studies, carried out by observer networks made up of the public and school classes, are ongoing in Europe. The potential advantages of similar programs for students, teachers, and the future of our prairie environment are many. The Alberta survey will be working with students in the years ahead to develop a following of young phenologists.

CONCLUSION

Phenology can help raise awareness of prairie habitats. The time is ripe for increased public education in environmental matters and in basic life sciences. Let us benefit from European examples where active observer networks have contributed centuries of bioclimatic information to their countries, with benefits to the nations and to the observers. Alberta's phenology survey is up and running and seeking ways to involve the province's children. For what better cure for environmental illiteracy than phenology, which makes the complex web of interactions between organisms and the environment so visible and fascinating?

ACKNOWLEDGEMENTS

Many thanks to Dr. Walter Moser for advice and inspiration. Essential funding and support were provided by the NSERC grant of Dr. Keith Denford, the Department of Botany, the Boreal Institute for Northern Studies, and the Recreation, Parks and Wildlife Foundation.

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ACHIEVING GOAL NUMBER 9 OF THE PRAIRIE CONSERVATION ACTION PLAN FROM THE CALGARY ZOO'S PERSPECTIVE

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INTRODUCTION

After listening to many of the talks during the first two days of the Prairie Conservation and Endangered Species Workshop, it is clear that some very positive, fantastic steps are being taken (or planned) to help conserve our prairie environment. The one missing element that we, as Educators, noticed however, was that very little was being done to ensure that the general public was hearing about these amazing programs. Unless the general public is aware of the studies being done, or the actions being taken toward conservation, they will not "buy in" to the programs and support them in the way every researcher or conservationist hopes.

The point has been made that we have neither the time nor the money any longer to concentrate our attention on individual species. We need to preserve whole habitats and ecosystems. Therefore, species which are getting individual attention (like the Swift Fox, *Vulpes velox*, or Grizzly Bear, *Ursus arctos*) need to be used in an "ambassadorship" role to become symbols for all Canadian species, endangered or not, in order to tell the public about the larger issues of habitat and ecosystem conservation.

Our purpose as presenters at this conference is to focus in on how the Calgary Zoo has tried to achieve Goal Number 9 (promoting public awareness of the values and importance of prairie wildlife and wild places) by using our animals as "ambassadors." Our larger objective, however, is to help each of you delegates to think about conservation education in general and how it can be worked into your programs to help elicit the public support needed to help conserve our prairie environment.

THE ROLE OF ZOOS

Although some people still view zoos as a menagerie of all kinds of strange animals kept in small cages for people to gawk at, there is a vast difference between the zoos of today and those of the past. The whole philosophy of exhibiting animals, why zoos exist, their roles, and missions has changed. Instead of bars and cooped up creatures, modern zoos (like the Calgary Zoo) attempt to recreate natural habitats for the benefit of both the animals (to promote natural behaviour) and the people (to help them place these animals in their proper environmental perspective).

The change in zoo philosophy has some important implications for conservation work as a whole, as well as specifically for the Prairie Conservation Action Plan. North American zoos have jointly committed themselves to conservation both globally and locally and have instituted a number of programs to work toward this end:

a) captive breeding of animals has stopped the need for capturing animals from the wild for display purposes.

b) International Species Inventory Systems (ISIS) are used to match the best individuals for breeding to ensure a healthy gene pool in captive populations.

c) Species Survival Plans (SSP) have been developed for 37 captive endangered species thus far to help maintain viable gene pools in case we must depend on this source to help save a species from extinction by supplementing wild populations.

d) Reintroduction programs for species are being conducted in coordination with many agencies (e.g., Swift Fox).

e) Rehabilitation programs help return injured or orphaned animals to the wild.

f) Research is conducted into various aspects of animal biology (e.g., husbandry, disease, diet, metabolism, reproduction, genetics), providing useful information for wildlife managers.

All of these are ways in which zoos currently help in the fight to save endangered species. There is, however, a limit to the effectiveness of these programs. Not every species can be helped this way nor is there enough room in zoos to contain all the world's species. The real key to species survival is through habitat protection and protecting existing wild populations. This, however, can only be done through awareness, understanding, and appreciation on the part of the general public. Promoting this awareness through education is the most important role of zoos today.

THE ZOO VISITORS

People started zoos and people still come to zoos because they have a natural affinity or desire to be close to animals. Zoos provide them with that opportunity in a nonthreatening way.

The vast majority of zoos are located in urban centres where, correspondingly, the vast majority of people live. These urban residents, by their sheer numbers, have probably the greatest influence on the conservation community yet they are also, generally, the least in tune with the natural world. Most of them, although they crave information about the natural environment, are just in the process of discovering nature. While people who visit our parks and natural areas may be just starting the race toward understanding natural history concepts, most urban visitors to zoos haven't even entered the starting blocks. Yet, these same people, if we can coach them into the starting blocks, can be some of the strongest supporters of conservation programs.

The opportunities for education are immense and they are very important, especially among the young visitors. An old Chinese proverb explains this best.

> "If you want to plan for 10 years, plant rice.
>
> If you want to plan for 50 years, plant a tree.
>
> If you want to plan for 150 years, teach the children."

HOW WE EDUCATE AT THE ZOO

Basically, all our education efforts at the Calgary Zoo can be broken down into two major areas personal and nonpersonal media. A discussion of each of these will, we hope, offer each of you a variety of ideas which can be used to promote your own projects.

Nonpersonal Media

Nonpersonal media consists of all the various means used to contact visitors which we can't reach in person through our interpretive programs (e.g., signs, brochures, flyers, automated videos, etc.). There are several levels of nonpersonal media used by the Zoo to help get our message across. Each has its own purpose and standards.

i) To attract visitors to our education programs we use a variety of "grabbers." Off grounds, the Zoo distributes a lure brochure full of Zoo images and information on facilities and displays at the Zoo. Newspaper ads, billboards, T.V., and radio spots help as well. Some advertise the Zoo in general, others advertise specific education programs. Once the visitor reaches the Zoo gates, they are given an Interpretive Flyer which lists all the interpretive talks happening at the Zoo. Other quick printed flyers are given out for special events when they occur, like "Meet the Keepers Weekend." More temporary sandwich board signs advertise special programs, as do posters in various buildings around the grounds. For schools, we produce and mail out a special "Discovery Course" brochure each year listing what programs are available, costs, and how to book.

ii) To provide information about our animals, plants, and prehistoric park models, we provide static signs at each exhibit. For these we have established certain guidelines or standards to help us maintain a uniform, professional look throughout the Zoo. Our desire is to create a park-like atmosphere where the animals and plants are the most prominent features. Our sign colours, therefore, are natural and not overwhelming (brown type on ivory background generally). Our illustrations must be very accurate and the content of the signs is based on the most recent material we can find, with attention paid to accuracy of information. The signs are designed to use a three level approach. Animal names are large and easy to read for the fast-moving, nonreading crowd. Text is broken up into main headings which themselves contain interesting messages for those who stop only momentarily. Illustrations are usually large and attractive and contain captions which also pass on information. The body copy is written to be informative but not overwhelming in length to provide more in depth information for the visitors willing to spend the time reading. Occasionally we tag on an extra sign to draw attention to a special event like a new birth.

iii) While illustrations help draw readers to a sign, actual touchable items or moveable parts increase reading of signs dramatically. The Calgary Zoo has opted, in recent years, to incorporate interactive displays where possible for this reason. In the Prehistoric Park actual fossils are glued onto the signs for visitors to touch. These receive a great deal of use and have been clearly shown to "hold" visitors at the information signs much longer than when only text and illustrations are present.

More typical interactive displays are located in the Children's Zoo (the Wheel of Wonder) and the Polar Bear Complex. Both displays receive heavy use. A new interactive caribou display is currently being designed and further displays will be created as funding permits in other areas of the Zoo.

Interactive displays are not without their problems, however. They require high maintenance and must be designed to withstand heavy use, vandalism, weather (if outdoors), and be able to be repaired easily. Unless a maintenance schedule and funding is put in place when they are installed, they will often sit broken, posing a source of frustration for the visitor rather than the beneficial media they can be.

iv) To further enhance a Zoo visit, people who are seeking even more detailed information can obtain it from brochures. A special Prehistoric Park brochure offers help identifying the dinosaurs. Future brochures will be designed to add to signage now being created about plants, animals, and habitats in the Conservatory.

For the Calgary Zoological Society members, "Dinny's Digest," our quarterly magazine provides articles on both our own animals and wider conservation issues. A "Zoo-to-You" column in the newspaper also passes on biological and conservation messages to the general Calgary community.

Personal Media

Personal media consists of all the interpretive programs, Docent contacts, school programs, media programs, special events, and general one-on-one discussions where a staff member or Docent interacts directly with the Zoo visitor or the public at large. Using personal media for educating the public is, without a doubt, the most effective means one can employ. Personally delivered messages have many advantages over nonpersonal signs, brochures, audio-visual productions, and the like. They are infinitely flexible, they don't break down, and they can be reprogrammed at any time. On the other hand, they are more expensive and they can't be everywhere talking to everyone.

Our personal programs use a multi level approach much like our nonpersonal ones do and can be broken down into the following categories:

i) Interpretive Programs. Each summer the Zoo hires seasonal interpreters and trains them to present a variety of programs which are conducted at preset times each day from mid-June until Labour Day at various animal enclosures, amphitheatres, and theatres throughout the Zoo. An interpretive flyer, given out at the gates, lets visitors know what talks are going on where and when so they can drop in as they please.

ii) Docent Programs. The Zoo has an active volunteer core of over 100 individuals whom we call Docents. These people receive an intensive 14 weeks of training (one full day a week) before graduating into Docent work. Docents present formal programs to school groups throughout the winter, both at the Zoo and in school classrooms. They also participate in Members' Programs and other special events and conduct informal "touch tables" and offer "animal handling" experiences to visitors at the Zoo on an informal basis throughout the year.

iii) Members' Programs. Throughout the year, special programs are conducted for Calgary Zoological Society members. Most are conducted on Zoo grounds but a few, like African Safari trips, Mt. Assiniboine Photography Retreats, or Whale Watching in the Baja take members farther afield to see wildlife in its true environment.

iv) Guest Speaker Series. For the public at large, the Education Department brings into Calgary special guest speakers to lecture on studies they are currently conducting. These are usually internationally known biologists or naturalists (like Jane Goodall or Rodney Jackson) who lecture at the Jubilee Auditorium, but local biologists are often featured as well (usually in a smaller venue). Special intimate dinner programs (Elite Eats) are also offered on the Zoo grounds for a higher fee. These talks promote the research of these individuals with the profits donated to their studies.

v) Media Programs. Along with the Guest Speaker Series, opportunities are set up for the media to interview the speaker, passing their message on to an even wider public audience. In addition, the Curator of Education, Brian Keating, conducts a weekly radio program on CBC's "Homestretch" and appears frequently on CBC's "Basic Black" as well, talking about various wildlife species or ecological concepts.

vi) Special Events. The Zoo's Marketing and Promotions Department conducts special events at the Zoo (such as Canada Day or Elephant Birthdays, etc.) which now have an Education component to pass on interpretive messages. At the Calgary Zoo, all programs presented by Education staff have a number of things in common.

i) All programs promote the philosophy of thinking globally and acting locally. Exotic animals from far away places are presented as "flagship species" or, in a sense, as spokespersons for animals and plants everywhere.

ii) All programs are ecology based. Discussion of animals and plants occurs within the context of the animal's habitat.

iii) All programs use an "edu-tainment" approach. Learning in an informal setting must be educational and entertaining or less learning seems to occur. Thus the coined word "edu-tainment."

As well, at the Calgary Zoo, our experience has taught us a couple of lessons which are worthwhile to share. These are not new, but they are always worth hearing again. Using the real thing works best. A real person talking about a real animal creates a personal commitment from the audience. Also training is important. No doubt a well trained person and a less well trained person could present the same program. However, the goal is to get an audience to demand more: to puncture the presentation facade. Once punctured, the speaker must "bleed" natural history information and not hot air.

SUMMARY

The participants at the Prairie Conservation and Endangered Species Workshop have the background and the kind of up to date information that educators need to create meaningful personal and nonpersonal programs. However, all the research studies and conservation initiatives undertaken by biologists and all the programs or nonpersonal media distributed by educators will not matter unless we develop a strong network of sharing the information that stems from research, or announcing the initiatives being undertaken to conserve an area, with the people trained to educate the public. We would like to challenge the biologists attending this conference to put forth the effort to pass on their information to educators wherever possible. As well, we challenge you educators to get in contact with the biologists to find out what they are doing and pass it on to the public. This is certainly the way we see ourselves contributing the most at the Calgary Zoo.

If we all make the commitment to work together and employ the educational techniques we have talked about today, especially with the urban public, we can achieve Goal Number 9. It is vital that we do achieve this goal for it is only through promoting public awareness of the values and importance of prairie wildlife and wild places that we will be able to ensure the public support needed to save our prairie environment and the species which depend upon it.

MANAGING WAKAMA VALLEY

Doug Cole
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Wakamaw Valley Authority was established in Moose Jaw in 1981. From the beginning, our perspective was that Wakamaw must show how people and wildlife use the land. Twinning human and wildlife use of the land facilitates educational and interpretive programs.

"Wakamaw" means the river of turns. The area we manage is inside the City of Moose Jaw along the Moose Jaw River. It was that river that brought people to the valley.

When creating an authority like Wakamaw, the stated objectives are very important. While interpretation may not be a stated objective in the charter, promotion of responsible land use should be identified. The theme of responsible land use provides a good basis for interpretation and education programs as well as land management programs.

When we started, there was little support from conservation agencies for wildlife interpretation in an urban setting. Any wildlife habitat inside city boundaries was apparently written off. Little outdoor education was provided in the school system. Twenty-one elementary schools in Moose Jaw with a staff of 280 educators were polled; only six were taking their classes outside of the school at least once a month. Hence, there was little support for urban wildlife programs when we started and there was little use by the groups that should be using it the most!

Groups like the Saskatchewan Natural History Society and Moose Jaw Natural History Society did not provide a lot of funding but did contribute expertise, photographs, and help getting educational programs going. Also a few teachers donated time to develop education programs. These were important beginnings.

Wakama is an urban park and urban parks must be for people. Special events like school group tours provide chances to get people investigating the river valley. Wakamaw is a series of nine parks that are being linked together with the wild animal park. Some areas are for high use recreation, some for low use recreation and others are conservation and environmental areas. Together, this creates a tremendous regional attraction.

Wakamaw includes 800 acres (323 ha) in the River Valley. Its existence is not apparent because it is concealed in the river valley. Much is heavily wooded and there are some small marshes; this habitat supports a rich diversity of wildlife including more than 40 species of nesting bird and more than 20 species of mammals.

The history of man's involvement in this area has not all been attractive. Drainage ditches and construction led to erosion and silting problems. Large amounts of dumping in the river valley had to be cleaned up. Diesel fuel outfalls were found where thousands of litres of diesel fuel spilled into the river from the CPR. By putting in some time and effort, we have had a substantial influence on the valley. To physically clean up and protect the river valley has cost $1.5 million. Additionally, governments and private businesses have spent 10 times that amount in their own clean-ups prompted by the people that are now using these areas.

By bringing people into an area like this, presence and education of visitors can lead to public pressure for clean-up and protection of the natural values of the area. At Wakamaw, river banks were stabilized, mercury pollution was cleaned up, thousands of trees and shrubs were planted and dump sites were cleaned up creating an attractive area which will become even more attractive in the future. The key to this progress was bringing people into the valley; our initial work made this possible.

A small group of volunteer educators created a series of education programs for Wakamaw. The Grade 1 program uses puppets to tell children about wildlife in the river valley. For example, Castor the Beaver tells how Beavers live, a raccoon puppet tells about Raccoons. The puppets are used outdoors; if Raccoon (*Procyon lotor*) tracks are found, the raccoon puppet comes out to talk about Raccoons. Programs have been prepared for grades 1 to 8. The availability of education programs is having some effect. The number of teachers doing regular outdoor education has increased from six to 25 and is growing. Teachers will get involved in outdoor and environmental education if programs and support are available.

Some agencies may be reluctant to make the first step toward better urban wildlife programs unless they are given some support. Use the resources available in your community (The Wakamaw Valley Authority produces a program called Wakamaw World for the local cable television channel that includes 15 minutes on events and 15 minutes on the natural environment of the valley). Consider volunteering for an urban park or wildlife agency as a way to stimulate better urban wildlife programs.

THE YORKTON ECOLOGICAL PRESERVE

Warren Hjertaas
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I think all of us attending this conference are conservationists at heart. There are many reasons why we are conservationists. Unfortunately, many people living in cities have very poor knowledge about wildlife. Therefore we must be educators if we are ever going to convince the general public of the benefits of conservation and the value of preserving natural areas.

I have lived most of my life in rural areas and moved to Yorkton 10 years ago. One of the sad facts I learned is that a person can spend their entire life in a city. They need not contact anything in the great outdoors. However, they must have fresh air to breathe, clean water to drink, and fresh food to eat. All of these are products of a healthy environment, of green fields, and clean streams and marshes.

The need, therefore, is to educate the public and since most people live in cities and towns, there is a great need for environmental education in urban areas. If the urban majority is not informed and taking a side on environmental issues, the conservation battles will be lost.

I think every city and town should have a natural area with a walking trail where the public can go to see, touch, smell, and hear nature. Not only will this preserve the natural area, it will create a great place for outdoor education and a place where anyone can go to relax and just enjoy a nature walk. Yorkton has such an area; it is called the "Ravine Ecological Preserve." I wish to tell you about our area and I hope you can find a natural area in your home town and not only preserve it but develop it as well.

Our area is heavily used for nature observation, walking, and outdoor education. The Ravine Ecological Preserve includes a ravine with a marsh, the wooded valley slopes, and some adjacent grasslands. The first part of our development was a nature trail around the marsh. The trail has many switch backs and loops; often you cannot see someone 30 m ahead on the trail. People like to feel alone with nature. A historic site on the west side of the marsh is included in the Ravine Ecological Preserve. The Historical Society is working with us to interpret some of the features of this site and thus we are combining natural and human history.

To shorten the nature trail and to provide a great interpretive aid, we constructed a board walk across the marsh. The board walk is a great place for teaching. Children express a great deal of enthusiasm when using dip nets and handling captured insects. Their experience also has a multiplier effect as the children often insist that mom and dad come to see the board walk and nature trail. The area is also used for less direct interpretation such as art classes.

When we lead school groups, we try to teach not just the names of plants, but to demonstrate differences in stems, leaves, and growth habits. Students tend to remember the differences between Poison Ivy (*Rhus radicans*) and Wild Sarsaparilla (*Aralia nudicaulis*). We show different and interesting strategies in plants like the carrion flower which climbs on other plants. We show them the Beaver cuts and how the Beaver uses the tree, how rabbits feed on trimmed branches, and how decomposers recycle the stump.

It is almost impossible to teach bird identification to a school class on one tour. We show different types of birds and how they use different environments. For example, we explain how the woodpecker makes its nest hole and how that hole becomes a home for other species later. We try to demonstrate other nest types and some other bird habitats.

The Yorkton Ecological Preserve is a city park managed by a special subcommittee under the Parks and Recreation Board. The Yorkton Natural History Society has taken the lead role in development of the area while the city role is gradually expanding in development and maintenance.

A final point I want to stress is that this project was started without any money, without a major approved plan, and without approval from the City. Once the area received regular use by visitors, the area had value and we were able to get City cooperation, get the area designated as a City Park, stop the dumping at one site in the ravine and obtain money for more expensive projects like the board walk and clean up of an old dump site. We started small. Our first step was to construct a trail that people could use and enjoy. I think that was very important to our success.

PROTECTION AND INTERPRETATION OF WILDLIFE IN WILD AREAS IN URBAN SETTINGS

Lorne Scott

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Regina was built along Wascana Creek, an intermittent stream with regular water flow during spring run-off. A small dam was created in 1908 and an area behind the dam excavated to impound water. The area has been a bird sanctuary since the early 1900s. As the City of Regina expanded, planners had the foresight to maintain a significant "green belt" around the man-made Wascana Lake. In 1961, the Government of Saskatchewan, City of Regina, and University of Regina created the Wascana Centre Authority to manage, develop, and preserve the 700 acres (283 ha) known as Wascana Waterfowl Park.

Throughout history there have been regular attempts to infringe on the unique wild area within Regina. For example, conservationists successfully defeated a proposal to develop a high rise apartment complex on Goose Island, a small man-made island. For years Goose Island has been home for the largest concentration of nesting Canada Geese (*Branta canadensis*) in Saskatchewan and perhaps Canada.

In recent years, as the City expanded along Wascana Creek, additional marsh land habitat has been added to Wascana Waterfowl Park.

Wascana Centre is best known for its resident population of Canada Geese. The flock was initiated in 1953 by Fred Bard, former Director of the Saskatchewan Museum of Natural History. At that time the larger subspecies of Canada Geese had all but disappeared from their former range on the prairies. As early as 1961 offspring from the Wascana Canada Goose flock, which consisted of free flying birds, were used to re-establish the birds in southern Saskatchewan. Over the years, eggs and/or goslings from Wascana have been sent as far away as Quebec, Florida, New Mexico, and British Columbia. In Saskatchewan, the Wascana Goose Flock is attributed to a large extent for successful reintroduction of Canada Geese throughout southern Saskatchewan.

Despite its location within the City, Wascana Centre has remained an important prairie wetland attracting a variety of birds including non-breeding pelicans and cormorants. The area is important to shorebirds, especially during the fall migration. Common Terns (*Sterna hirundo*) nest on Tern Island each year. During favorable water conditions, a colony of 75 to 100 pairs of Eared Grebes (*Podiceps nigricollis*) nest. Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*), Common Yellowthroats (*Geothlypis trichas*), shorebirds, and several duck species also nest at Wascana.

A variety of mammals including Mink (*Mustela vison*), Beaver (*Castor canadensis*), Muskrat (*Ondatra zibethicus*), Red Fox (*Vulpes vulpes*), Coyote (*Canis latrans*), jack-rabbit, and ground squirrels can also be observed. Occasionally White-tailed Deer (*Odocoileus virginianus*) can be seen.

For many years Wascana has been used for nature study and interpretation. In recent years, upwards of 6000 school children visit Wascana during the year. School classes from out of Regina come to Wascana for nature study and appreciation. To accommodate school classes, a marked nature trail has been established in an undeveloped area closed to the general public. Teacher orientation workshops are conducted prior to the class visits. The Regina Public School System also have staff which help with the class visits to Wascana. Many unscheduled groups and tens of thousands of individuals visit Wascana annually. Even on Christmas Day, families come to feed the geese.

Naturalists and birders frequent Wascana Centre to look for rare birds. In recent years, the first Saskatchewan record of a Green-backed Heron (*Butorides striatus*), Mississippi Kite (*Ictinia mississippiensis*), and Black Guillemot (*Cepphus grylle*) have all been seen in Wascana Centre. The Waterfowl Display Ponds, consisting of a couple of acres, are a popular area. A variety of captive and crippled waterfowl species including American White Pelicans (*Pelecanus erythrorhynchos*) are held in this enclosed area throughout the spring, summer, and fall. The younger school children and public at large frequent the Display Ponds regularly. An interpretive display panel and walkways are provided for the visiting public.

The interaction between the public and birds is excellent. Canada and Snow Geese (*Anser caerulescens*) nest and raise their young unmolested, despite the daily presence of people. Vandalism resulting in several dead birds has only occurred once in 18 years. No boating, no public access to nesting islands, limited public access to certain areas, and the lack of access trails to other undeveloped areas seems to limit disturbance by humans and provide adequate protection for wildlife. At the same time, public access to areas such as the Display Ponds and key observation points along the shoreline seems to satisfy public demands for viewing and enjoying wildlife.

The conference chairman asked that I address the topic of what should be done with respect to wild areas in urban settings. First and foremost, a constant vigilance must be maintained to control human encroachment on these natural areas. Developers, unaware or unconcerned about natural areas and wildlife, view wetlands and native prairie as wasteland waiting to be developed. As urban populations expand, we must ensure that natural areas within our cities are also expanded.

There is a constant need for additional interpretation facilities in many of our centres. The Province of Alberta and City of Winnipeg are to be commended for their series of nature centres and their interpretative programs.

One of the dangers I foresee is urbanites becoming complacent about the future of wildlife on the prairies. In many large centres today, the city dweller can see flocks of waterfowl and even uncommon species such as Merlins (*Falco columbarius*), pelicans and Burrowing Owls (*Athene cunicularia*) on their way to and from work. It no doubt occurs to many people that if all this wildlife occurs within our city limits, then wildlife must still abound across the prairies. Unfortunately, such is not the case. The truth is urban communities have done a far better job than rural communities in ensuring that natural areas are maintained. We need to enlist the support of urbanites in our continuing efforts to conserve natural areas throughout the prairies. Many people may be content to see wildlife within their city and not really care about or become involved with wildlife conservation across the prairies.

INTERPRETING URBAN WILDLIFE AND WILD AREAS - DISCUSSION

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Discussion focused on establishing and managing urban natural areas and bringing wildlife into urban parks. Suggestions which could be used in other areas are summarized.

(1) City parks, including nature parks, are for people and must be designed for people. The resulting use will generate the support necessary to maintain and protect the area. The Yorkton Natural History Society was unable to persuade their City to set aside a nature reserve and so established a nature trail on city land without approval. The resulting use and media coverage led directly to designation of the Ravine Ecological Preserve as a city park.

(2) Use volunteers to stretch limited budgets for urban wildlife programs and do not limit the range of tasks for volunteers. Wakamaw volunteers write a newspaper column every second week and produce a 30-minute television program for the Cable Channel once a month as well as conducting many other activities. All the Yorkton trails were designed, built, and maintained by volunteers except for the boardwalk. As a result, the cost to develop the original trails for the Ravine Ecological Preserve, excluding the boardwalk, was less than $2000.

(3) The City Parks and Recreation Board is very useful in bringing different groups together and integrating programs, although this is less important for Wascana in Regina. Wakamaw in Moose Jaw keeps close ties with Parks and Recreation to avoid duplicating programs. The Yorkton Ecological Preserve is run by a subcommittee of the Parks and Recreation Board which brings everyone interested in the area together. This has helped sort out conflicts with the golf course, for example. Patience and compromise also help get people working together.

(4) City parks and school yards are large land areas which could serve wildlife. While they have important recreational mandates and cannot become natural areas, they could be groomed a little less and incorporate a few more shrubs and trees in order to offer a little more habitat for wildlife. Such parks may actually be more popular with children; there is some evidence that children prefer playing where they can hide in bushes and generally enjoy the richer wild environment.

(5) City park boards should include a nature park in their park system plan. This would provide a park system with high intensity use areas, low intensity use areas, and natural areas. Wakamaw was planned in this way.

(6) The Nature Conservancy of Canada and Wildlife Habitat Canada have helped finance Wakamaw interpretive projects and land acquisition and may do the same for other communities. The Saskatchewan Natural History Society has been a source of some financial support and expertise for both Yorkton and Wakamaw.

(7) We should always stress the positive side of how many educators, school groups, or members of the general public use our natural areas and wildlife interpretive programs. This should be communicated to groups like departments of education to help build support for these programs.

(8) Use of parks by school groups and other major users should be recorded. The educational service provided by parks can be demonstrated and institutions such as Alberta Education can be approached with a request for help in paying bills or upgrading service. This system works for a number of zoos and aquariums.

(9) Centres that have interpretive areas should invite use by surrounding communities. Lorne Scott pointed out the irony of farm children coming into Regina to see wildlife.

(10) There is a strong perception in managers of urban parks that parks are mowed grass and trimmed trees. Public pressure on groups like the Wascana Centre Authority and city managers is needed to provide natural areas or at least to attract more wildlife into their recreation parks simply by doing less grooming.

(11) Many communities have an area with potential for nature interpretation. Any group starting an interpretation program must first get access to the site and/or protect it. Active and passive interpretation should begin immediately whether by creating a trail or conducting periodic nature walks. Once you have a pamphlet or some signs, do not stop there; this is only the beginning. There is a large audience for wildlife in cities but it requires continuing efforts to keep the audience and to keep the audience growing.

(12) The importance of urban wildlife is difficult to overestimate. Winning conservation battles of the future will depend on a public knowledgeable and sympathetic to wildlife. With most people now living in urban centres, the greatest opportunity to bring people into contact with wildlife is in the urban area. Urban wildlife programs encourage wildlife through habitat work and educational programs and have great potential to increase awareness and appreciation of wildlife.

RESEARCH AND CONSERVATION: PRELIMINARY OBSERVATIONS

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There is an element of irony in the fact that as this secular century draws to a close, research has become a talisman to which we cling with reverential faith. Faced with an epidemic of AIDS, we take refuge in the belief that research will find a cure. Confronted with troubling questions concerning the consequences of economic development for a fragile environment, we confidently commission a study. We are even prepared to consume power generated by a nuclear reactor before we know how to dispose of the radioactive waste, safe in the knowledge that science will find a way.

Nowhere has this talisman wielded greater influence than in agriculture where, as a result of the wonders of genetic research and the marvels of the engineering sciences, we have tamed a semi-arid desert and secured a mastery over the environment. Have we indeed?

Perhaps the time has arrived to re-examine what research is all about, not to discredit inquiry but to rediscover the measure of confidence it deserves. Research is about systematic inquiry. Inquiry into what? The empirical world about us. How does this inquiry take place? Not in one, but many ways. The methods of investigation are determined, in part, by the nature of the subject matter. Laboratory experimentation works well in genetics but it is not worth a tinker's damn in the study of human history and society. There are, however, a number of properties that are common to all scientific disciplines, be they physical, biological, or social. They are these. Scientists must make assumptions. Sometimes they err in doing so. The limits of the human mind compel us to select matters for investigation out of context. Inquiry is therefore always partial, incomplete. Intense specialization in the sciences accentuates this tendency.

While we try to control for it, the results of an investigation may in part be a function of the methods we deployed to study an issue. Finally, the theoretical framework within which we choose to work may blind us in ways that inhibit the development of knowledge and understanding.

It should come as no surprise to discover that scientists can and often do arrive at different conclusions when they undertake an investigation of a common issue or problem. How do they handle the situation? If they are wise, they will regard their own results with a healthy measure of skepticism, acknowledging that they are engaged not in "search" but "research"; the re-investigation of issues and problems.

There is something else that has to be said. Science and research do not generate answers. To claim otherwise is to advance, at best, a half-truth. Research generates "answers" and at the same time creates "new questions." There is a difference. Penicillin is an answer generated by research, is it not? Wrong. It solved one set of problems only to permit the creation of a new and unforeseen set of difficulties. Herbicides, pesticides, artificial fertilizers, and large modern machinery have given us dominion over the Canadian prairies, have they not? Wrong. They have resolved one set of issues only to land us in a new ecological mess. It does not follow that research is irrelevant to the resolution of environmental and conservation issues and problems. The results of scientific investigation are important when considered within the limitations that always attend research. One should use scientific knowledge but not abuse it. Do not attribute to it properties it can never enjoy.

The abuse of science often takes another form, a subtle and invidious one. We can all recall occasions when confronted with a controversial, difficult choice, we evade and postpone the pain of making a decision by claiming: "We need more information." We escape our responsibilities by commissioning another study on the dubious grounds that "we do not know enough." Rubbish. We can always take this "way out." We shall never know enough. To those who are paralyzed by this state of affairs, may I remind you that the species *Homo sapiens* has survived so far on far less knowledge than we possess today. The fact is, we shall always have to make difficult decisions in the light of limited knowledge. Inquiry and research should not be used as an escape mechanism for two simple reasons. It is an act of deception and it demeans the scientist in the bargain.

While it is correct to admit that we will never know enough, it does not follow that we are bereft of information. Often, when confronted with a new environmental problem or conservation issue, we are tempted to commission an investigation at the outset before checking to determine whether indeed we are dealing with a problem about which we are reasonably knowledgeable. The fact is, we know a lot. The problem is, the knowledge is often neither integrated nor easy to locate. There is a need for the design and development of a public data bank that addresses the requirements of both the scientific and lay communities concerned about environmental issues and conservation. Finally, we must always remember that the commissioning of research costs money, often a lot of money. At present, neither the public nor the private sector is convinced that research, particularly in regard to the environment and conservation, is an investment priority.

In consequence, the training and education of scientists and a responsible deployment of scientific labor across the nation have been seriously impaired. This situation is not going to change overnight, despite the mounting political pressure to alter our national and regional agendas of priorities. In the short run, we shall be forced to support and fund less research than we should and make better use of the present deployment of scientific labor, particularly within the universities and the public service. There is a hiatus between university and government research that is neither desirable nor responsible. We must consider and lay plans to make more effective use of scientific personnel that is already on the public payroll, regardless of the venue of employment.

THE ROLE OF RESEARCH IN PRAIRIE CONSERVATION

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Garret Hardin (1977) stresses the importance of first understanding and subsequently proving that non-viable political systems should be rejected. In other words, one should have intuition first, then rigor. Realizing the pathogenic effects of conscience and that it is in the long run self-eliminating, society must adopt coercive measures to enforce mutually agreed upon goals. We have intuitively understood not only the "tragedy of the commons" (Hardin 1968) but also the diminishing quality of private lands, water and wildlife habitat on the Canadian prairies for decades. The central problem in instituting corrective measures has been control of the land base. Private entrepreneurs have failed to properly steward resources because of short-term markets, lack of information, misinformation, and greed. Therefore, we have arrived at a point in time when these meetings were called to address a crisis situation.

What has to be done is not being addressed by the standard biological research that most of us are involved in. Results from these studies are important in establishing the requirements for survival of given species and communities but they do not get at the underlying problems that have led to the current situation. Most of the problems facing prairie conservation are in a class known as "nontechnologically solvable" (Crowe 1969). Within the research communities at universities, the natural sciences and social sciences have established insular subdivisions and relegated their individually unsolvable problems to each other. If the social sciences cannot find an answer it must await a technical solution from the natural sciences. On the other hand, if the natural sciences cannot find a technical solution, the problem is given to the social sciences. In essence, the integration needed to find workable, but usually not absolute, solutions has been avoided.

Two major problems that need to be addressed are (1) intrinsic responsibility in modern agriculture and (2) improving accountability among bureaucrats who are given responsibility to protect public resources. Both science communities must take a long hard look at current agricultural policies in light of how they affect soil, water, and wildlife. The intricate web that now encircles private land production is so laden with well-meaning short-term programs that the long-term viability of the basic resources may have been forgotten. Since many of these programs are directed by the public sector, maintaining a reasonable level of "symbolic disassurance" in the public as to the accountability of bureaucrats may be an important first step toward solution (Crowe 1969).

In his keynote address, Monte Hummel clearly stated that the World Wildlife Fund Canada has already spent more dollars than usually allotted on the Prairie Conservation Action Plan and that further funding was not available. His basic mandate to the conference was that he expected to see results "on the ground" within 5 years. In his address, Jim Patterson provided information that clearly revealed a massive increase in the cultivation of class 4 to 7 lands in the prairie region. A combination of economic forces and government incentives had caused the increase. Patterson stated that this trend not only must be stopped, but also reversed, and fragile lands be put back into protective cover. In addition, the Prairie Conservation Action Plan calls for 10 to 12% of the prairie land base to be renewed as representative areas for regionally-recognized natural communities. The problems, therefore, have been clearly defined and concern both the private and public lands of the region. Securing the land base is primarily a political process. Renewing the biotic communities is primarily a natural science process. The overall plan must include both scientific communities if it is to succeed.

During this conference, we heard a number of disturbing statistics that provide a perspective on the problem we face. Among the most revealing are the following:

(1) one-half of Saskatchewan's soils are subject to wind and water erosion,

(2) two million acres (808,000 ha) of Saskatchewan's soils suffer from salinity problems,

(3) only 5% of agro-Manitoba is public land and only 1% is prairie crown land,

(4) the P.F.R.A. pastures at Val Marie, Saskatchewan are not in a condition to serve as the base for a national park,

(5) 22% of the natural wetlands on the Manitoba prairies are gone and an additional 23% are so drastically changed that they provide little or no wildlife habitat,

(6) as much as 75% of the upland wildlife habitat on the prairies is gone or drastically altered, and

(7) from 50 to 74% of the upland habitat in prairie Alberta is gone. Therefore, the problem has proceeded far beyond the inventory stage. We know that action must be taken and that both private and public lands must be involved. All that inventories accomplish now is to count the ever-dwindling numbers of natural communities or declining populations of endangered and nonendangered species.

Although each of us has limited personal experience, I would like to share a few recent observations. In spring 1987, three researchers in Manitoba had to inspect and analyze 80 farm dugouts; they found 20 that were biologically capable of supporting aquaculture. Water quality was so poor in some that a green slime occurred within one week after ice-off. There was no evidence of aquatic life in most dugouts. On provincial crown land adjacent to my farm, a landowner attempted to stop a hunter from using the land. When the Conservation Officer checked the complaint, he found that the landowner had been illegally grazing the land for 10 years; his penalty was that he had to buy a permit. Adjacent to the same crown land is a newly-developed gravel pit started by a private contractor with municipal consent. The pit is large enough to put this museum in and the large rocks sorted out are bulldozed into the forest. There are no provisions for reclamation. Three miles down the road lies another section of provincial crown land that was recently designated a Wildlife Management Area. On the opening day of Elk (*Cervus elaphus*) and Moose (*Alces alces*) hunting in 1986, 26 hunters occupied the one square mile area! One might be prone to believe that I have seen unusual events. The evidence presented at this conference, however, suggests that environmental degradation has become a way of life on the Canadian prairies.

The remaining question is how to tie this information to research. It is obvious that we must set priorities or nothing will be accomplished in the 5-year period specified. Stopping and reversing present land use trends must be our number one priority. We simply cannot fool ourselves any longer that the purchase or bequeathment of a few acres of land each year will provide the land base necessary to achieve the goals established. This places emphasis on socio-economic program implementation and reduces efforts such as inventories and standard biological studies. We must first procure the land base necessary to sustain prairie communities, then move toward renewing the communities. Social scientists must be called upon to identify potential changes in management programs that will not only meet our objectives but also be acceptable to the public. This may involve radical rethinking of our modus operandi or simply re-employing the common sense that used to drive prairie agriculture. It does no good to say that international forces are beyond our control. Rather, it is functional to say that catering to the international forces has led us into the degradation of our own natural resources. Therefore, we must look for innovative ways to allow survival of farmers during the period of transition from the current destructive practices to policies that allow both sustainable agriculture and conservation of natural communities.

To be functional any new approach should have benchmarks along the way to ascertain progress towards the goal. I would propose that we strive to first recover our public lands. These lands were meant to serve the needs of all of society and we must convince government that conservation needs are now more urgent than those of agriculture. When P.F.R.A. becomes the Prairie *Land* Rehabilitation Administration and introduces the broader meaning of multiple use to federal crown lands, we shall know we are on the right track. Grazing on public lands should occur only when it is deemed compatible with biological community preservation. There is precedence for the phase out of private use of public lands with the national parks. The reduction can be orderly and responsible and it will be opposed.

Another bench mark will be reached when we, as scientists and concerned citizens, effectively utilize our rights to promote a reasonable level of "symbolic disassurance" in the public about the ability of bureaucrats to effectively regulate natural resources. Crowe (1969) clearly outlines the evolution of public agencies and warns that infiltration by special interest groups is a natural phase . The fact that our resource bureaucracies have served the single master of agriculture for so long should create ample suspicion that we may have to re-institute the necessary corrective feedbacks to assure sensitivity to the greater needs of the wider public. If our public lands are extricated from current destructive use, they will serve as examples of proper land management for private landowners. Instituting corrective programs on private lands will be a longer term objective because private landowners will first have to be convinced that sustainable practices are in their own best interests.

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EDUCATING ENVIRONMENTAL PROFESSIONALS AT THE NATURAL RESOURCES INSTITUTE, UNIVERSITY OF MANITOBA

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The purpose of this paper is to describe the role of the Natural Resources Institute (NRI) as it relates to the objectives of the Prairie Conservation and Endangered Species Conference. In order to accomplish this, I shall first highlight the NRI program components; second, address how the Institute currently is meeting the conference objectives; and finally, recommend possible actions which might be considered for the future. I should point out that my remarks represent my personal beliefs and not necessarily University of Manitoba policy.

NRI PROGRAM HIGHLIGHTS

The Natural Resources Institute at the University of Manitoba is a fully accredited academic unit offering the degree of Master of Natural Resources Management (M.N.R.M.). The mandate of the Institute is threefold: (1) to teach resources management skills leading to the M.N.R.M. degree, (2) to conduct research on current problems and issues of natural resources management, and (3) to provide a forum for examination of resource topics and thereby promote public education. In short, the program is patterned after the traditional academic duties of teaching, research, and extension.

Academic staff at the Institute include three full-time and a number of part-time appointments, as well as Adjunct Professors representing federal and provincial government departments and private sector agencies. In addition, we draw upon academics in other resource areas at the University. Our total student enrollment in most years approaches 50, with approximately 20 entering first year annually. Since the establishment of the program in 1968, over 200 graduates have found employment with government and the private sector primarily in Canada. Some graduates have also returned to their home countries or chosen to travel abroad to further their opportunities.

Teaching

The objective of the teaching program is to take professional resource managers who understand the complex nature of natural resource problems and educate them to use rational processes to resolve natural resource problems. This involves building upon the base of each student's undergraduate degree in a particular discipline by introducing new concepts from other resource areas. The end result is the development of a professional with not only a firm grounding in one subject but also a general understanding of the associated concerns of other disciplines. This is exactly the sort of person that will be capable of meeting the natural resource management challenges into the 21st century.

Each candidate receives a 54 credit-hour program of course work spread over two full academic years. The core curriculm (36 credit hours) includes instruction in natural resources, management approaches, research planning, resources law, economics, biology, and the earth sciences. Optional and/or prerequisite courses are available in agriculture, geography, botany, zoology, engineering, and other areas. The Institute integrates special seminars, conferences, and field activities in its teaching. A number of courses draw heavily on contacts in government and the private sector for presentation and discussion of important topics.

Research

The research program of the Institute is centred around the practicum - an applied research undertaking required from each student before graduation. The practicum is not unlike a typical master's thesis but stresses the development of skills in problem/issue identification, research design, data collection and analysis, and report preparation. Practicum projects address a broad range of issues in the natural resource sector and are funded by government and private agencies.

Each student is supervised throughout the research process by an advisory committee comprised of University faculty, client representatives, and other experts. The committee meets at regular intervals to assess student progress, provide assistance, and ultimately to judge whether the student has fulfilled the practicum requirements. The criteria for acceptance include evidence of technical integrity and quality of the final report, evidence of utility of the work, and evidence that the student has demonstrated the ability to conduct independent applied research. The student is not left in isolation at any time during the research process and must attend to present-day realities in arriving at useful conclusions.

Faculty at the Institute engage in various individual research projects separate from practicum supervision. These projects have recently included wildlife ecology and management, environmental assessment, policy and program evaluation, and northern development.

Forum (Extension)

NRI faculty and students participate in a number of functions which are designed to further public knowledge of natural resources. Presentation of and assistance with conferences and seminars are one means of achieving this end. Recent activites have included the Northern Forest Owls Symposium, Manitoba Public Forum on Environment and Development, and the NRI Free Trade and Natural Resources Forum.

Another activity which addresses our forum role is the Northern Field Seminar - a 10-day "travelling classroom" which visits the people working in Manitoba's natural resource sector. Students are able to observe the practice of natural resources management as demonstrated by farmers, fishermen, trappers, loggers, miners, guides, planners, biologists, government officials, and multinational corporation managers. In many areas of Manitoba, the Field Seminar represents the only contact that local individuals have with the University.

A final example of our extension efforts is our active participation in the development and operation of the Canadian Association of Resource Managers. This organization has been involved in promotion of natural resources management, public education, and facilitation of information exchange among interested individuals.

NRI's CURRENT ROLE IN MEETING CONFERENCE OBJECTIVES

The NRI program has been developed over the past 20 years with particular attention paid to the central theme of encouraging the development and application of innovative approaches in natural resources management. This is also the basic concern of this Conference. With respect to the three specific Conference objectives (improving agriculture-wildlife linkages, implementing the Prairie Conservation Action Plan, and conserving endangered species), the NRI has made some contributions while meeting our mandate described earlier. Teaching, research, and extension functions of the NRI have played a role with respect to each of the above objectives.

Improving Agriculture-Wildlife Linkages

As discussed earlier, teaching at the Institute is geared toward the utilization of real-world situations in educating professional resource managers. Several courses direct attention to the complex question of achieving a compromise between two competing resource interests. The resolution of agriculture-wildlife concerns on a wide scale or for a specific case study will continue to be integrated in our teaching.

As well, several students have and are continuing to address these types of questions in their practicum research. At least 30 such reports have been produced by NRI students over the years. The support of agencies such as the Manitoba Departments of Agriculture and Natural Resources, Environment Canada, Ducks Unlimited, Wildlife Habitat Canada, and World Wildlife Fund has been encouraging.

Extension efforts in the area of agro-wildlife linkages have also been an important concern. The Field Seminar has focused on allowing students to meet with rural landowners and discuss their perspectives on this issue. Student and faculty participation at the Annual Meeting of Manitoba Conservation Districts has also furthered this function in past years.

Implementing the Prairie Conservation Action Plan

The NRI has been active with respect to this objective through research, and more specifically, through practicum research projects. Several students have assisted in the preparation of species status reports or recovery plans [i.e., Burrowing Owl (*Athene cunicularia*) Plains Pocket Gopher (*Geomys bursarius*)] and others have investigated the feasibility of species re-establishment [i.e., Greater Prairie Chicken (*Tympanuchus cupido*) Swift Fox (*Vulpes velox*)]. Many students have addressed the need for protection of threatened habitats for prairie species in studying other research issues. This objective will become an even more important part of NRI research initiatives in the coming years.

Conservation of Endangered Species

Once again, the importance of conservation has been stressed in both teaching and research. From the theoretical perspective, the need to maintain species in all ecosystems is discussed from several viewpoints including the biological, economic, philosophical, and technical. This teaching function is applied in many courses as well as in practicum research. Several students have considered the question of endangered species and/or habitat conservation as direct or indirect objectives of their research undertaking. As with the preceding conference objective, this issue is likely to gain greater prominence in our program in the coming years.

RECOMMENDATIONS FOR FUTURE ACTIONS

Given the current reality of budgetary restraint being practised by all organizations, it is dangerous to make recommendations which might be considered contrary to that necessity. It is important, nonetheless, to develop "Wish Lists" without being too constrained by the requirements of economy and restraint. The achievement of the Conference objectives will in fact only be possible with a strong commitment from individuals from all agencies interested in ensuring the conservation of Canada's agriculture and wildlife resources. This support will need to take the form of additional dollars and/or personnel to ensure that the job is done effectively. Bearing this in mind, then, I offer the following personal recommendations for the consideration of all individuals interested in prairie conservation and endangered species in Canada:

(1) Develop new university courses on agriculture and wildlife, waterfowl ecology and management, prairie conservation and endangered species management.

(2) Develop university agro-wildlife apprenticeship programs.

(3) Develop 5-year research priority lists with dedicated funding for graduate student projects at interested prairie universities.

(4) Seek assistance from interested academics at prairie universities in the establishment of a Prairie Centre for Applied Research on Conservation.

(5) Promote an Annual Conference on Prairie Conservation and Endangered Species.

(6) Offer university-sponsored workshops or conferences and encourage the participation of university faculty.

In closing, I would like to say that the challenge is waiting for us. I hope that we are prepared to accept it, for the sake of ourselves and the generations to follow. To quote Aldo Leopold, "There are some who can live without wild things, and some who cannot...." I believe that the time for action has come for those of us who cannot.

THE ROLE OF UNIVERSITIES IN ENVIRONMENTAL EDUCATION

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As we prepare to enter the 21st century, we find ourselves at a pivotal point in human history facing a mounting environmental crisis of our own making. This is a time when our universities should provide leadership and focus society's attention on the global problems we face while attempting to find new directions and new paths. The rapid rate of change, driven by the pace of technological advances, has shortened the effective period of "long-range" planning. Business and government rarely look more than a few years down the road and are locked into short-term profit and election cycles. Our universities may be unique among institutions in having the luxury of true long-term planning. Unfortunately, to a large extent, they are abdicating their responsibilities. Universities increasingly play a role of uncritical subservience to the short-term interests of government and business as opposed to taking a leading role in examining the direction, morality, and sustainability of our society.

A cursory examination of western Canadian university calendars reveals the diversity of approaches to environmental education. These range from the classical organization into departments of forestry, wildlife, and fisheries to relatively new interdisciplinary programs in "Environmental Design" or "Natural Resource Management." The general assumption of all these programs is that we need to produce environmental specialists ranging from foresters to urban planners. While this is undoubtedly true, it is increasingly important to realize that environmental training and understanding is needed not only for these specialists but for all people in all walks of life. Stan Rowe (Professor Emeritus, University of Saskatchewan) once suggested to me that one of our major problems is that we misplace ecology in the grand scheme of things. Rather than considering it a subdiscipline of biology (on par with anatomy, physiology, or genetics), he suggests it should be recognized as the umbrella under which most other disciplines logically fall. It is from such a perspective that I wish to address the role of our universities. It should be stated at the outset that my thoughts are undoubtedly highly colored by my association with the University of Saskatchewan which has not had a history of being innovative in the area of environmental education.

The University of Saskatchewan provides a great breadth for traditional study with colleges of medicine, nursing, veterinary medicine, law, agriculture, education, etc. It lacks, however, any of the applied environmental colleges or departments such as forestry or fisheries although the new Toxicology Research Centre offers a program for graduate students. An undergraduate "interdisciplinary program" in Land Use and Environmental Studies is offered but this is primarily a program chosen from pre-existing classes in traditional areas of study. Our only attempt at an interdisciplinary class in environmental education at the University of Saskatchewan, Man and the Biosphere, ended in failure after what I felt was a very exciting beginning in the early 1970s. The rift between the hard-core sciences and the arts and social sciences was apparently too wide and, with a lack of higher administrative support, we subsequently reverted back to our safe, discipline-oriented approach to teaching. Other universities have managed to keep such classes alive and well. Called by various names, Human Ecology, Biology and Human Concerns, Ecology and Human Affairs, these classes offer the potential for an interdisciplinary approach to important global issues, issues that can only be addressed if approached from all viewpoints.

Ideally, environmental awareness should permeate and form the basis of nearly all activities and disciplines of the university. We should produce medical doctors, engineers, teachers, farmers, politicians, and businessmen who are "environmental professionals" in the sense that they carry out their jobs at the local level in a way that is compatible with global sustainability. At present, universities have a tendency to produce narrow-visioned technicians who, not surprisingly, engage in band-aid approaches to real world problems.

We must make fundamental changes in the direction we offer to our students and to society as a whole. Our medical training should change its main emphasis to prevention rather than treatment of disease. There is no limit to the level of medical technology that is possible but the cost becomes insurmountable if such care were to be made available to all people. We must emphasize the importance of good health through good diet and personal habits rather than attempt to replace lungs that have been carbonized due to smoking. Engineers must place greater emphasis on solving problems using appropriate, soft technology that does not create more problems than are solved. We should direct our efforts towards increased energy efficiency and conservation as opposed to "satisfying the increasing demands" for more energy. Agronomists must develop a new agriculture that does not mine the soil but enriches it. The development of perennial polycultures that require little or no tillage and reduced energy inputs are desperately needed if we are to sustain dry land agriculture on the prairies. Perhaps most importantly, we must produce a generation of teachers that can communicate to their students our complete dependence on the ecosphere and how we must change our pattern of life in order to ensure sustainability.

Over the past few years, interest in environmental issues has been rekindled. Global problems can be seen clearly by anyone willing to look and there is a growing awareness that this generation must come to grips with them. In fact, a progression of thought on these matters can be extracted from convocation addresses at the University of Saskatchewan over the past few years. Dr. Robert L. Rausch focused on the magnitude of the problems we face in his convocation address in October 1985:

> Whether a specialist on the writings of Goethe or a specialist on the immune responses to parasites, we all have an equal interest in the welfare of the thin and fragile surface-layer in which life on our planet is sustained. We are all aware of the potential threat of a man-made cataclysm and many of us try to contribute to efforts to minimize the risk of international conflict. We are also confronted with another disaster, also man-made, but less easily perceived, whose cumulative effects are potentially no less severe, that is the world-wide desolation of ecosystems. No less than other organisms, man is a component of the ecosystem in which he lives. That perception is often lost in our eagerness for development, economic growth and profit, all of which seem essential for what we deem benefit and progress.... Irrespective of our diversity of attitudes and beliefs, we cannot pretend that overpopulation by the human species is not the cause of world-wide degradation of ecosystems.

Jim MacNeil, secretary general of the World Commission on Environment and Development and principal architect of the commission's report "Our Common Future," spoke on this problem at the spring convocation in 1988:

> The world's economy is today totally interlocked with the earth's ecology but our institutions are not. In every country that we visited, we found that those responsible for managing the environment are almost completely divorced from those responsible for managing the economy. As a result, both are increasingly ineffective.
>
> All over the world, our institutions are engaged in planetary management on the pay later plan. First, they try to capture the benefits of economic activities - the jobs, income, profits, tax revenues - for their electors or customers. Then they try to transfer the costs of managing the wastes from these activities to someone else - to a neighboring municipality (witness garbage disposal), to a neighboring country (witness acid rain), to the global commons, the oceans, the atmosphere and outer space (witness chemical and nuclear wastes). Strong countries try to transfer costs to weak ones. And this is where you come in; our leaders daily face the irresistible temptation to transfer costs to the weakest group of all - future generations....
>
> A long journey begins with a small step, as the Chinese say, and the transition to sustainable development will be a long journey. The scientific community, industry, private and community groups but, perhaps most of all, our universities and educational institutions, will play a crucial role....
>
> Many universities today are re-examining ancient purposes and seeking to define new goals tailored to the needs of the future. What goals will advance a future that is prosperous, just and secure? How can universities best serve their communities, their provinces and the world at large? Defining a new direction is always a difficult challenge but the notion of a

> sustainable future may provide one of the keys. Some university leaders think so. Some are already framing courses around "Our Common Future."

Most recently, Blaine Holmlund addressed the University of Saskatchewan graduating class in the fall of 1989 while he was acting President. He emphasized the role of the University in changing the path we are on:

> I believe the primary focus of this and other universities in the future must be to preserve and enhance the capacity of this planet to create and sustain life for the well-being of future generations. Such an aim will require a fundamental change in the ethos of this institution. This University grew up in a culture which accepts unquestioningly the need to modify and control the environment (conquer nature) for the benefit of the individual, the community as a whole (local, national, global) and future generations. Many of the University's educational programs, its efforts to create new knowledge and the attitudes it inculcates in its students have been directed to that end.
>
> There is now sufficient evidence to suggest that the human race can modify the global environment and may to such an extent that life as we know it can no longer exist on this planet. Never in its history has mankind faced such a threat to its welfare and survival. This threat will diminish only when enough of us realize that it is real and respond accordingly. Universities, because they are responsible for educating future leaders, bear a special responsibility for the welfare of future generations. Our tasks must be to inculcate in students the sense of responsibility that each must share in the care and maintenance of the fragile bio-systems that sustain life on this planet....
>
> This University, like others, is at a watershed. The pathway of change it has followed has been channelled by an ethos which seems to be leading us to an endpoint none of us would seek. But we are the ones who make the ethos. Culture, what all of this means to us, is a human creation, our creation. A new pathway of change directed by a new ethos must be developed and followed. As the new ethos slowly replaces the old, all spheres of thought and activity within the University will inevitably be affected.

Obviously these three people all recognize the problem and its magnitude, yet little has changed on the University of Saskatchewan campus. Other universities have made better progress in developing new approaches to environmental education but until it becomes the underpining of our entire education system, we shall continue to spin our wheels. Our universities must begin to address the attitudes and issues surrounding the main problem that confronts us, growth, both population growth itself and the per capita increase in energy and material resource utilization. We must find a way to convert from a growth-oriented society to a stable, conserver society that can be sustained indefinitely on this planet.

4. PRAIRIE SHOREBIRD CONSERVATION

THE CANADIAN WILDLIFE SERVICE SOUTH AMERICAN SHOREBIRD ATLAS PROJECT AND THE WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK

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INTRODUCTION

Many shorebirds breeding in the Canadian arctic undertake long migrations to wintering areas around the coast of South America, some as far south as Tierra del Fuego (Morrison 1984). The principal objective of the Canadian Wildlife Service South American Shorebird Atlas Project has been to determine the major wintering areas used by Nearctic shorebirds on the coast of South America. The surveys, carried out in January/February between 1982 and 1986, covered some 28,000 km of the South American coastline and included all parts of the coast thought to contain significant habitat for shorebirds (Figure 1). The surveys, which were conducted in collaboration with counterpart wildlife agencies in each country, were flown in a variety of fixed-wing aircraft and helicopters at a height of 40-50 m above ground level and speed of approximately 160 kilometres per hour. All shorebirds seen were recorded and the two principal observers remained the same throughout the surveys. This paper reviews the main results of the work (Morrison and Ross 1989) and outlines the Western Hemisphere Shorebird Reserve Network conservation initiative.

RESULTS

More than 2.9 million Nearctic shorebirds were counted during the surveys around the coast of South America, with small, medium-sized, and large species making up 80%, 16% and 4% of the total, respectively (Table 1). The surveys clearly identified the most important coastal wintering areas used by various categories and species of shorebirds (Morrison and Ross 1989).

Some 2.1 million small sandpipers were counted on the north coast of South America, the majority of which were considered to be Semipalmated Sandpipers, *Calidris pusilla*. The most important wintering areas occurred in Suriname and French Guiana, with 64% and 19%, respectively, of the total. Other major areas included the north-central coast of Brazil between Belem and Sao Luis, with 9% of the total, and the Orinoco delta, with 3%.

Small sandpipers occurring along the southern parts of the Atlantic coast consisted principally of White-rumped Sandpipers, *Calidris fuscicollis*. Particularly important wintering areas included the Argentinian and Chilean sectors of Tierra del Fuego, with 32% and 15% of the regional total of 73,000; other important areas included coastal lagoons in southern Brazil and in Uruguay, with a further 21% and 4%, respectively, of the total.

Nearly 112,000 Sanderlings, *Calidris alba*, were counted, with the most important wintering areas on the ocean beaches of the Pacific coast: the Pacific, Atlantic, and north coasts held 88%, 8%, and 4%, respectively, of the total. Most of the Sanderlings on the Pacific coast occurred in Peru and Chile, which held 68% and 31% of the regional total. Areas of major concentration in Peru included the ocean beaches fronting the Sechura Desert (32%) and the coast near Pacasmayo (10%), with areas of central and southern Peru also holding substantial numbers (19% and 15%, respectively). Moderate to large numbers occurred in central and southern Chile, with some 10% of the west coast total in Chiloe.

On the Atlantic coast, the most important area for Sanderlings was the coastline of Rio Grande do Sul in southern Brazil, with 71% of the Atlantic coast total of 9,300.

Most Black-bellied Plovers, *Pluvialis squatarola*, (total 27,300) occurred in the northern part of the continent, with major wintering areas being found on the north-central coast of Brazil (54%) and in Suriname (15%), and smaller, more localized concentrations on the Caribbean coast of Colombia (5%), northeastern Brazil (5%), and Peru (5%).

Ruddy Turnstones, *Arenaria interpres*, were most numerous on the north coast of the continent, and fair-

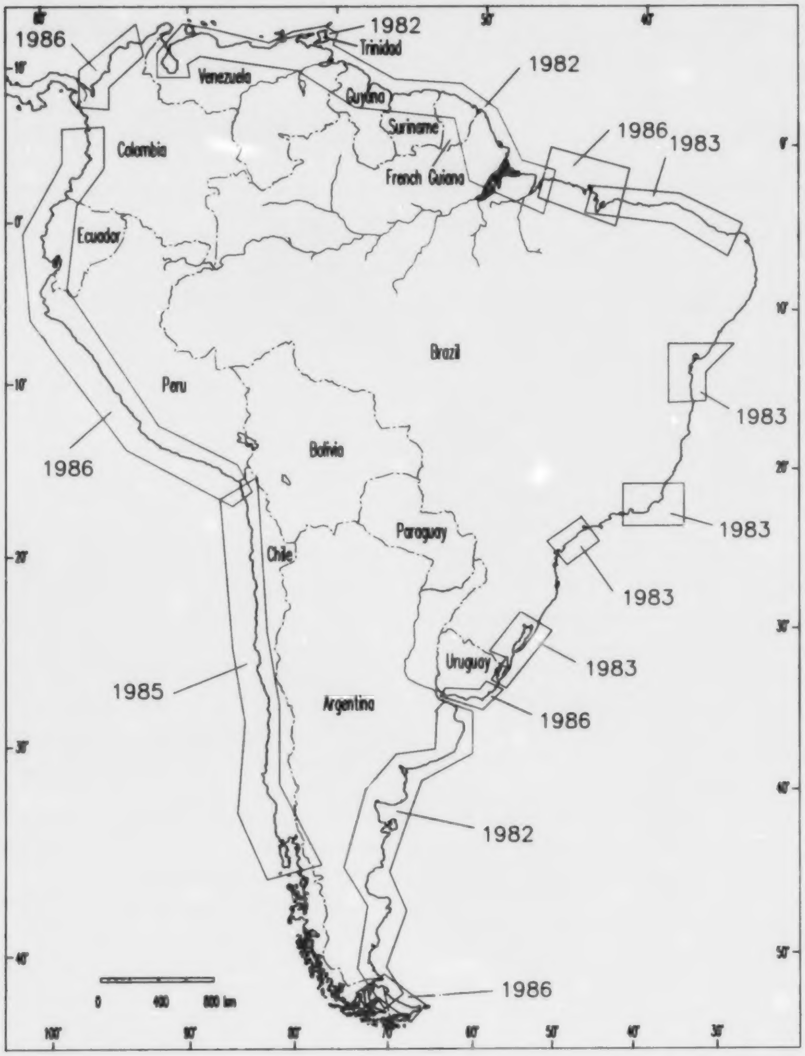

1986
1982
Trinidad
Venezuela
Guyana
Suriname
French Guiana
1982
1986
1983
Colombia
Ecuador
Brazil
Peru
1983
Bolivia
1986
1983
Paraguay
Chile
1983
Uruguay
1983
1985
Argentina
1986
1982
0 400 800 km
1986

Figure 1. Areas and years of coverage of aerial surveys carried out during the Canadian Wildlife Service South American Shorebird Atlas Project, January/February 1982-1986.

ly common on the Pacific coast, these areas holding 86% and 10%, respectively, of the continental total of 23,500. The north-central coast of Brazil was the most important wintering area, holding 76% of the South American total.

Most (91%) of the 91,000 yellowlegs (*Tringa flavipes* and *T. melanoleuca*) were found on the north coast of the continent, with the majority occurring in the Guianas (Suriname 73%, Guyana 8%, French Guiana 6%).

The most important wintering grounds for the Red Knot, *Calidris canutus*, were in Tierra del Fuego and along the Patagonian coastline of Argentina. Of the total of 76,400 counted, 55% occurred at one site, Bahia Lomas near the eastern entrance to the Strait of Magellan in Chile in Tierra del Fuego. Other important concentrations in Tierra del Fuego were found near Rio Grande (5,100) and in Bahia San Sebastian (4,400) in Argentina. On the Patagonian coast of Argentina, important areas were found around the Golfo San Jorge (8,700), near Bahia Bustamante (7,400), and around the Peninsula Valdes (5,000). No knots

Table 1. Summary by size category of Nearctic shorebirds counted during aerial surveys on the coast of South America, January/February 1982-1986. For details and species included in each size category see Morrison and Ross (1989).

	Length km	Size Category				
		Small	Medium	Large	Unclas.	TOTAL
Venezuela	1939	94476	32473	1405	1411	129765
Trinidad	484	12393	986	259	0	13638
Guyana	479	9808	11618	340	0	21766
Suriname	370	1346625	148168	21536	10000	1526329
French Guiana	388	394334	32906	2094	1500	430834
Brazil	7852	252812	110258	35147	0	398217
Uruguay	624	3137	6960	422	0	10519
Argentina	4548	41429	30195	20806	194	92624
Chile	5488	51186	44432	32019	0	127637
Peru	2775	86675	23367	2234	0	115276
Ecuador	1385	2274	3485	4006	0	9765
Colombia	1601	29673	12238	1049	0	42960
Total	27933	2327822	457086	121317	13105	2919330

were recorded on the Pacific coast, although the species is known to occur there.

Short-billed Dowitchers, *Limnodromus griseus*, were restricted to the northern part of the continent, which held 97% of the total of 48,900. Particularly important areas included the mangroves and coastal lagoons of Suriname (45%), north-central Brazil (17%), and central Venezuela (15%); smaller numbers occurred in the Orinoco delta (6%), Guyana (6%), and French Guiana (5%).

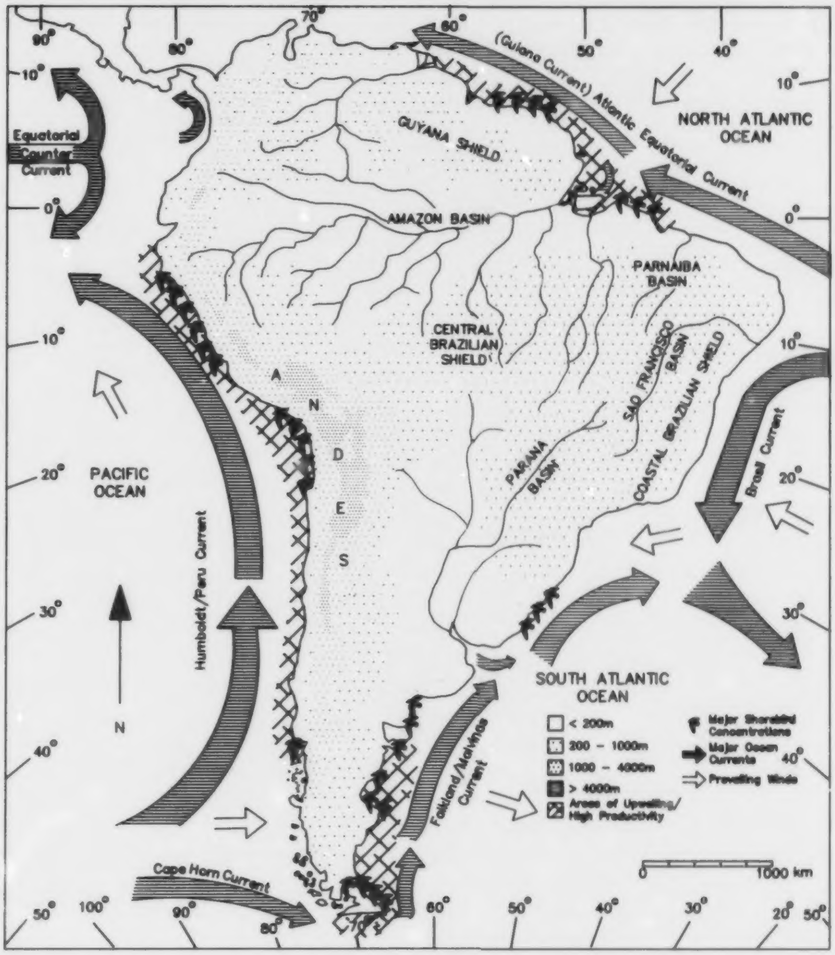
Willets, *Catoptrophorus semipalmatus*, (total 44,400) were found mostly (89%) on the north coast of the continent. The two major wintering areas were in north-central Brazil (49%) and in Suriname (35%).

Coastal wintering areas for Hudsonian Godwits, *Limosa haemastica*, were in the far south of the continent, with 72% and 28% of the total of 45,500 birds occurring on the Atlantic and Pacific coasts, respectively. The most important sites were in Tierra del Fuego, with Bahia San Sebastian, Argentina and Bahia Lomas, Chile, supporting 43% and 23% of the South American total. A further 28% of the total was found in the Chiloe area of southern Chile.

Whimbrels, *Numenius phaeopus*, were rather widely distributed, occurring principally on the north and Pacific coasts of South America. Three main wintering areas were evident, with north-central Brazil and Suriname on the north coast, and the Chiloe area on the Pacific coast supporting 44%, 13%, and 25%, respectively, of the total of 25,000 counted on the surveys.

DISCUSSION

Major coastal wintering sites of Nearctic shorebirds in South America are located in areas where geomorphological and environmental (e.g., climatic, oceanographic) conditions combine to produce habitats which are particularly productive (Figure 2). For instance, major wintering areas on the north coast in the Guianas are found where sediments discharged from the Amazon River are deposited to form extensive mudflats. The highly indented north-central coast of Brazil, formed by a series of drowned river valleys, consists of a series of wide, shallow bays with a variety of substrate types and extensive mangrove development, resulting in highly productive habitats of importance to a range of species. In Tierra del Fuego, high tidal ranges and waters rich in nutrients have produced highly productive habitats in areas where



(Guiana Current) Atlantic Equatorial Current
NORTH ATLANTIC OCEAN
GUYANA SHIELD
AMAZON BASIN
PARNAIBA BASIN
CENTRAL BRAZILIAN SHIELD
SAO FRANCISCO BASIN
COASTAL BRAZILIAN SHIELD
PARANA BASIN
Brazil Current
Equatorial Counter Current
PACIFIC OCEAN
A N D E S
Humboldt/Peru Current
N
SOUTH ATLANTIC OCEAN
Falkland/Malvinas Current
Cape Horn Current
< 200m
200 - 1000m
1000 - 4000m
> 4000m
Areas of Upwelling/ High Productivity
Major Shorebird Concentrations
Major Ocean Currents
Prevailing Winds
0
1000 km
90°
80°
70°
60°
50°
40°
30°
20°
100°
10°
0°
10°
20°
30°
40°
50°

Figure 2. Areas of major shorebird concentrations on the coast of South America in relation to some of the main geographical and environmental features of the continent.

sediment deposition has occurred or where the geomorphology has resulted in extensive interidal zones, such as at Bahia Lomas and Bahia San Sebastian. On the Pacific coast, the long ocean beaches most favoured by Sanderling are found where the cool, nutrient-rich waters of the Peru (Humboldt) Current have produced a very productive marine and coastal environment.

CONSERVATION

The survey results demonstrated clearly that coastal wintering populations of shorebirds in South America are concentrated into a restricted part of the species' ranges, with substantial percentages often occurring at only a limited number of sites. Similar results have been obtained from many other parts of the birds' ranges, particularly at staging sites. This phenomenon is of considerable conservational significance, since it implies that if environmental problems in a one key area are capable of causing major damage to a substantial proportion of a population, the entire chain of key sites forming the migration routes of the birds must be kept intact if conservation is to be ultimately successful.

Four aspects of the biology of shorebirds give particular concern for their conservation (Myers et al. 1987b). The first is the above phenomenon of concentration, which places large segments of the population at risk at the same place and time. Second, life history characteristics, including low reproductive rates, uncertain conditions on the breeding grounds, and high adult survival, make shorebird populations particularly vulnerable to factors reducing adult or subadult survival. Third, most migration appears to be critically timed to coincide with food and habitat availability along the route, so that disruptions would have drastic consequences for the birds' ability to complete their migration. And fourth, many of the sites used by shorebirds are also prime targets for development by mankind.

The present research, in conjunction with studies in other parts of the birds' migration ranges, has led directly to the concept of setting up a series of linked reserves that would protect the key sites used by the birds throughout their ranges (Myers et al. 1987a). Such an international approach, involving the creation of a Western Hemisphere Shorebird Reserve Network, will be essential if the future conservation of shorebirds is to be effective.

ACKNOWLEDGEMENTS

Funding for the South American Shorebird Atlas Project came principally from the Canadian Wildlife Service Latin American Program. Extensive support was received from a wide variety of counterpart agencies, government, and non-government organizations, and individuals, as outlined in Morrison and Ross (1989).

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THE WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK AND THE PRAIRIE SHOREBIRD PROGRAM

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ABSTRACT

This paper presents the history, purpose, function, and responsibility of the Western Hemisphere Shorebird Reserve Network.

In 1987, the Canadian Wildlife Service, Western and Northern Region, initiated a prairie shorebird program. Aerial surveys of approximately 150 lakes in 1987 and 1988, in combination with ground survey data and data from the literature, led to the identification of 17 major shorebird staging areas in prairie Canada by December 1988. In 1989, additional ground surveys added to the data base, bringing the total to 32 major staging areas in prairie Canada. Steps to ratify these sites under the Western Hemisphere Shorebird Reserve Network (WHSRN) are under way. A total of two Hemispheric Reserve sites and 30 Regional Reserve sites are proposed.

The prairie shorebird banding program of 1988 and 1989 banded approximately 2000 shorebirds at Little Quill Lake, Saskatchewan. Captures of previously banded birds and observations of our birds in other countries are reported. Future research plans for shorebirds in prairie Canada are also discussed.

THE WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK

The WHSRN was initiated back in the mid 1980s as a program to protect shorebird staging areas. Shorebirds need protection because their populations are particularly vulnerable to human interference, since they concentrate in great numbers in a few locations along migratory pathways. At times, large proportions of entire populations stopover at a single site.

In the late 1800s, market hunters in Canada and the United States were able to kill innumerable shorebirds at such sites. Even the smallest sandpipers "peeps" were considered good eating; dozens could be killed with a single shot. In 1916, the Convention for the Protection of Migratory Birds was signed by Canada and the United States and resulted in the protection of migratory birds including shorebirds. The only shorebirds that can be legally hunted in Canada and the United States today are snipe and woodcock. Increasing human encroachment on wetland areas continues to threaten shorebird populations.

Habitats used by migrating shorebirds are mostly coastal or interior wetlands and grasslands. These areas are amongst the most productive environments in the world, providing great natural and economic benefits to mankind as well as to wildlife. Many human activities depend on the healthy biological functioning of wetland ecosystems. In the USA and southern Canada, however, 30 to 40% of all wetlands present when Europeans reached the continent have been developed. There is continuing pressure for human exploitation from construction, commerce, agriculture, power projects, pollution, and recreation; such pressures exist in one form or another throughout shorebird ranges in both North and South America. The dependence of shorebirds on wetland for their survival makes them an excellent indicator of the health of these important biological systems.

During the past decade, internationally-coordinated programs of research by such agencies as the Canadian Wildlife Service (CWS), Manomet Bird Observatory, Philadelphia Academy of Natural Sciences, Brazilian Banding Office, and others have identified key areas used by shorebirds in North and South America and have demonstrated movements of birds between them.

Each key area forms an essential link in a chain of sites stretching from the breeding grounds to the wintering areas. Each link provides the resources needed by the birds to complete the next step in the cycle. For conservation to be effective, it is essential that all the links in the chain be maintained. The objective of setting up a Western Hemisphere Shorebird Reserve Network is to create a system of reserves, "Sister Reserves," linking all the critically important areas throughout shorebird ranges, thus maintaining the integrity of their migration pathways.

The first major step towards the development of the WHSRN was the Shorebird Sub-Committee of the International Association of Fish and Wildlife Agencies (IAFWA), of which Canada is a member, developing and passing Resolution No. 7 in 1985.

Resolution No. 7 indicated that the IAFWA (1) supported a concept of developing a reserve system in North America of essential migratory shorebird habitat, (2) would cooperate with the World Wildlife Fund, various States, Provinces, and others to delineate essential shorebird habitats in the Western Hemisphere, (3) would support future efforts to encourage South and Central American countries to take part in establishing a reserve system, and (4) would encourage all participants to recognize the need for an interim Shorebird Management Plan. Resolution No. 7 led to the IAFWA joining the World Wildlife Fund as founding sponsors of the WHSRN. The first official Reserve was designated in 1986 at Delaware Bay in the United States.

The WHSRN is presently run by the WHSRN Council which is composed of representatives from the IAFWA (including Canadian representation), National Audubon Society, Manomet Bird Observatory, and World Wildlife Fund. Participation by South and Central American countries is also being sought. The WHSRN Council provides a service to participating agencies. It is not a governing body nor does it lobby for site protection. The role of the Council is to stimulate the shorebird reserve network development and to oversee the functions of the Network on behalf of participating agencies. This includes (1) ensuring that the available information pertaining to shorebird use areas is collated, (2) reviewing nominated sites to ensure they meet the criteria for reserve designation, (3) ratifying these nominations, and (4) providing a focal point for information dissemination.

Sites being nominated to the Reserve Network must meet certain biological criteria and be nominated by an individual, organization, or agency(s) responsible for management of the area. In Canada, this means that nomination of almost any site requires the agreement of both the provincial government in which the site is located (land managers) and the federal government (responsible for the migratory bird resource). Sites can be nominated as either Hemispheric Reserves or Regional Reserves. Hemispheric Reserves must have at least 250,000 shorebirds using the site annually or at least 30% of a species flyway population. Regional Reserves must have at least 20,000 shorebirds using the site annually or at least 5% of a species flyway population.

To date there are two reserves officially designated in Canada. Both sites are found in the Bay of Fundy and are designated as Hemispheric Reserves. It is estimated that the Bay of Fundy supports at least 1.4 million shorebirds during migration. The Shepody Bay Hemispheric Reserve, located at Mary's Point, New Brunswick was designated on 8 August 1987 and supports over 462,000 shorebirds annually of which 95% are Semipalmated Sandpipers. The Minas Basin Hemispheric Reserve located in Nova Scotia was designated on 10 August 1988 and supports a similar number of migrating shorebirds.

Research in other regions of Canada has identified other major staging areas. Steps are, and will continue to be, taken to have these areas designated under the WHSRN. In prairie Canada, work by the Canadian Wildlife Service with cooperation from other government agencies, non-profit organizations, and individuals to acquire an understanding of shorebird population levels and distribution has been under way since 1987.

PRAIRIE SHOREBIRD PROGRAM

In past years, little research on shorebird populations has been undertaken in prairie Canada. This and the momentum of the Hemispheric Shorebird Reserve Program in North and South America (see Myers et al. 1987a, 1987b, Hicklin 1988) led to the initiation of a prairie shorebird program by the Canadian Wildlife Service in 1987.

Surveys

CWS conducted aerial surveys in 1987 and 1988 throughout the southern half of Alberta, Saskatchewan, and Manitoba. Over 100 lakes were surveyed. Survey methods involved the use of a Cessna 172 RG Cutlass aircraft flown at a height of 25 m, with two observers on one side of the aircraft. All observations were recorded by hand-held tape recorders. Birds were identified to species whenever possible, or were classed into groups based on their size (i.e., medium, small, or large shorebirds). Each water body was divided into sections to assist separation of the data into manageable units. At some sites, ground data were collected in conjunction with aerial surveys; further definition of species composition was then possible in these areas.

Ground data were also collected in 1987, 1988, and 1989 by staff of CWS, Alberta government, Saskatchewan Natural History Society, Beaverhill Bird Observatory, other non-profit organizations, and individuals. Using all data, we attempted to define the major shorebird staging areas during spring and fall migration on the prairies. The results of these surveys show that Chaplin/Old Wives Lake and the Quill Lakes in Saskatchewan meet Hemispheric Reserve criteria and that 11 sites in Alberta, 15 in Saskatchewan, and 4 in Manitoba meet Regional Reserve criteria as defined by the WHSRN (Fig. 1).

Chaplin Lake (Fig. 2) is a 6360 ha, intermittent saline lake which is broken into a number of sections by a series of dykes and roads. A total of 64,446 shorebirds was estimated at Chaplin Lake during aerial surveys on 24 May. In ground surveys conducted the same day, 63,155 of these birds were identified to species. Results of Chaplin Lake aerial surveys take into account results of ground surveys from sections A, B, and L (Table 1). In sections A and B combined, 48% of the birds seen were Baird's Sandpipers (*Calidris bairdii*) with the remainder consisting of 40% Sanderlings (*Calidris alba*), 10% Semipalmated Sandpipers (*Calidris pusilla*), 1% Red Knots (*Calidris canutus*) and 0.5% White-rumped Sandpipers (*Calidris fuscicollis*). Extrapolating the ground survey results across the whole lake but excluding sections K, L, and M which were different habitats, there would have been 24,840 Sanderlings and 29,808 Baird's Sandpipers on Chaplin Lake on 24 May 1987.

Old Wives Lake, a 33,020 ha, intermittent, saline lake, is located approximately 15 km southeast of Chaplin Lake (Fig. 2). A total of 59,773 shorebirds was estimated from the air. Ground surveys were only conducted on Section D of Old Wives Lake. We found that 48% were Semipalmated Sandpipers. If the species composition for Section D was indicative of that for the whole lake, then there were approximately 26,814 Sanderlings and the same number of Semipalmated Sandpipers on Old Wives Lake on 24 May.

For Old Wives/Chaplin Lake, we therefore saw a total of 51,654 Sanderlings which represents 46.2% of the 111,815 wintering on the South American coast (Morrison and Ross 1989, J.P. Myers, pers. comm.). Other significant data for the proposed Chaplin/Old Wives Lakes Reserve include: 292 Piping Plovers (*Charadrius melodus*) sighted in 1984 representing 11% of the Great Plains population (Haig et al. 1988) and 7100 Wilson's Phalaropes (*Phalaropus tricolor*) sighted on Chaplin Lake on 20 June 1984 (Harris et al. 1985).

At the proposed Quill Lake Hemispheric Reserve, data collected demonstrates that at least 215,000 shorebirds annually use the lakes for staging. No turnover rate has been applied to these data, thus it is entirely reasonable to assume that well over 500,000 shorebirds use these lakes annually.

Other significant observations from the proposed Quill Lakes Reserve include 23,498 Sanderlings on 28 May 1988 which represent 24.1% of the South American Pacific Coast Wintering Population (SAPCWP) (Morrison and Ross 1989), 2202 Hudsonian Godwits (*Limosa haemastica*) in the fall of 1987, 1988 and 1989 representing 17.2% of SAPCWP, 308 Piping Plovers (Harris et al. 1985) representing 11.6% of the Great Plains population, 29,483 Red-necked Phalaropes (*Phalaropus lobatus*) in 1988, and 1123 Red Knots on 26 May 1989.

Detailed surveys at Little Quill Lake show that shorebirds utilize adjacent marshy wetlands and saline sloughs as alternate feeding sites and, more importantly, for roosting. Surveys in 1987 showed that birds feeding along the south shore of Little Quill Lake were leaving that location at sunset and moving into the adjacent wetlands to roost. Arrival at the roost sites was followed by 1 to 2 hours of activity which involved preening and feeding. Considerable movement on the roosting basin was recorded for most species, except the American Avocet (*Recurvirostra americana*), although most individuals of a species congregated into distinct groups. This latter behavior was particularly noticeable in the Hudsonian Godwit, American Avocet, Dowitchers (*Limnodromus* sp.), and Stilt Sandpiper (*Calidris himantopus*). Yellowlegs (*Tringa* sp.) and the various "peeps" were scattered throughout the basin, although the latter showed flocking behavior when disturbed.

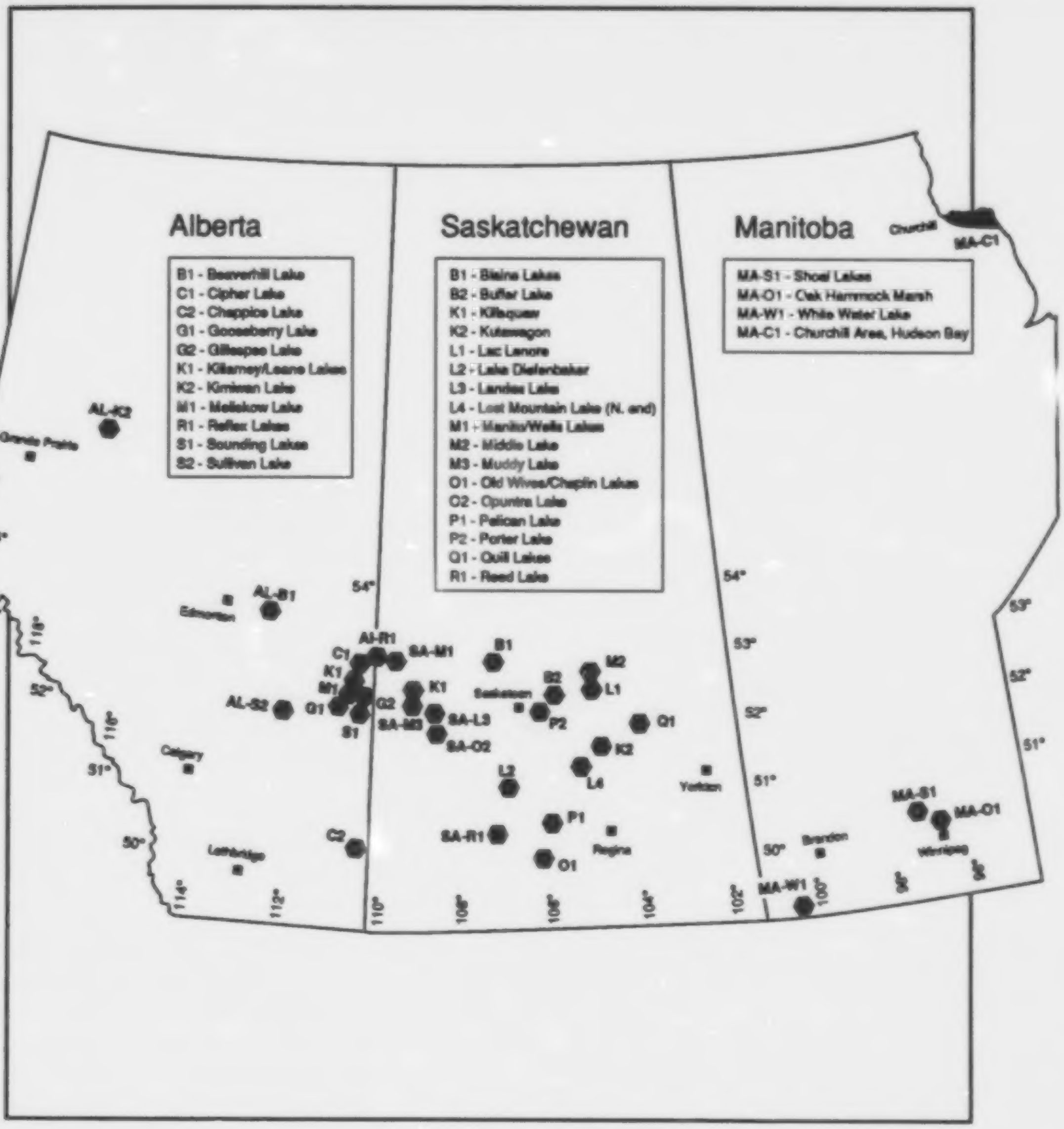
Alberta
B1 - Beaverhill Lake
C1 - Cipher Lake
C2 - Chappice Lake
G1 - Gooseberry Lake
G2 - Gillespee Lake
K1 - Killarney/Leane Lakes
K2 - Kimiwan Lake
M1 - Metiskow Lake
R1 - Reflex Lakes
S1 - Sounding Lakes
S2 - Sullivan Lake
Saskatchewan
B1 - Blaine Lakes
B2 - Buffer Lake
K1 - Kiltaquaw
K2 - Kutawagon
L1 - Lac Lenore
L2 - Lake Diefenbaker
L3 - Landias Lake
L4 - Last Mountain Lake (N. end)
M1 - Manito/Wells Lakes
M2 - Middle Lake
M3 - Muddy Lake
O1 - Old Wives/Chaplin Lakes
O2 - Opuntra Lake
P1 - Pelican Lake
P2 - Porter Lake
Q1 - Quill Lakes
R1 - Reed Lake
Manitoba
MA-S1 - Shoal Lakes
MA-O1 - Oak Hammock Marsh
MA-W1 - White Water Lake
MA-C1 - Churchill Area, Hudson Bay
Churchill
MA-C1
AL-K2
Grande Prairie
Edmonton
AL-B1
AL-R1
SA-M1
C1
K1
M1
AL-S2
G1
G2
S1
SA-M3
K1
SA-L3
SA-O2
B1
B2
M2
L1
Saskatoon
P2
Q1
K2
L4
L2
Yorkton
P1
SA-R1
Regina
O1
Calgary
C2
Lethbridge
Brandon
MA-S1
MA-O1
Winnipeg
MA-W1
120°
54°
53°
118°
52°
116°
51°
50°
114°
112°
110°
108°
106°
104°
102°
100°
98°
96°

Figure 1. Waterbodies meeting criteria for designation as a WHSReserve in Alberta, Saskatchewan, and Manitoba.

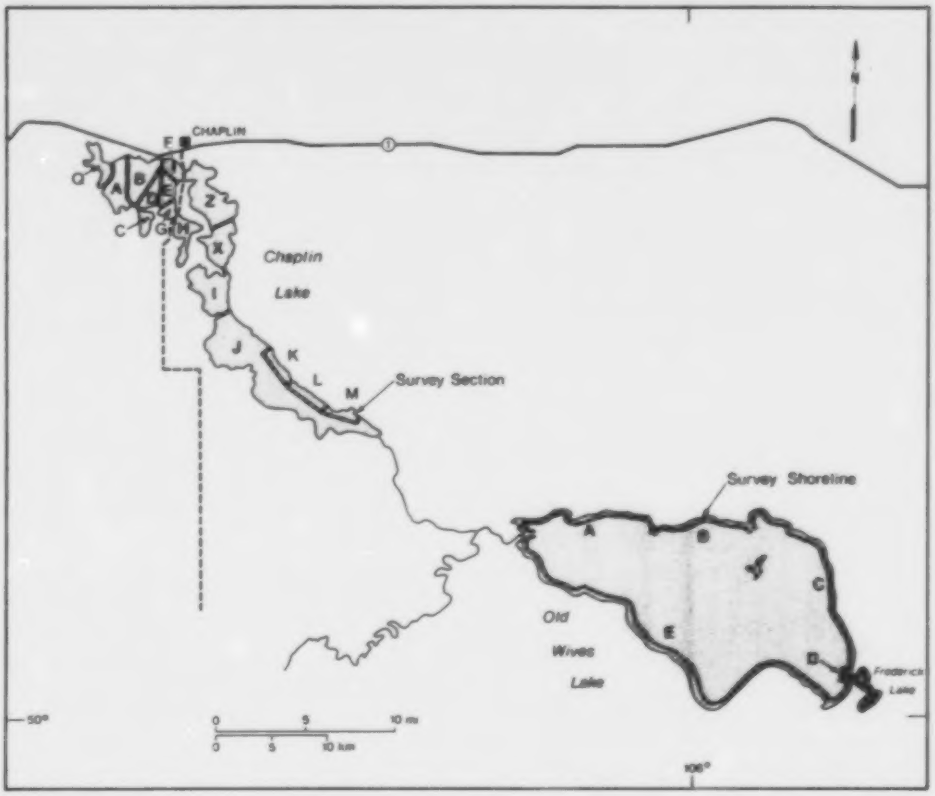

Figure 2. Location of transect section surveyed by air on Chaplin and Old Wives lakes, Saskatchewan on 24 May 1987.

Space limits the presentation of data (Table 2) to that acquired at those lakes which meet, or approach, the criteria needed for designation as a Regional Reserve (Fig. 1). Additional information on specific reserves or species populations is available from Dickson and Smith (1988), Smith and Dickson (1989), and Morrison and Ross (1989).

Banding Program

In order to define wintering grounds and turnover rates of prairie-staging shorebirds, a banding program was initiated in 1988 and continued in 1989 on the south shore of Little Quill Lake, Saskatchewan. This banding program is also part of the North American Waterfowl Management Plan Project (NAWMP).

This project will examine staging site tenacity, habitat relationships, time budgeting, and turnover rates of shorebirds throughout the Quill Lakes Management Unit which is defined by the NAWMP. Results of this work will enable a multi-species management approach to be used at the Quill Lakes under the NAWMP. In 1988, 1,480 shorebirds were banded while only 379 were banded in 1989 (Table 3). The continued drought in prairie Canada accounts for the decrease in birds banded in 1989 despite an increased effort. To date, there have been a total of nine sightings of birds banded by this program in other locations and/or sightings or captures of birds banded elsewhere (Table 4). Of particular interest is that the two South American records for Semipalmated Sandpipers which related to the Little Quill Lake area were both from just off the Venezuela coast, Araya Peninsula and Aruba. Additional data needs to be collected in both North and South America before migratory routes or wintering and staging site relationships can be defined.

Table 1. Shorebird survey results of Chaplin Lake conducted on 24 May 1987. Sections of the lake indicated by letters.

Species	A	B	C	D	E	F	G	H	I	J	K	L	M	TOTAL
American Avocet		4		2			1	50	53	63	50	12	4	239
Marbled Godwit								1	7	3	12	16	5	44
Killdeer											16	3	2	21
Red Knot	70	279												349
Red-necked Phalarope		10										20		30
Wilson's Phalarope		4								21	1	2	2	30
Black-bellied Plover		1								23		16		40
Sanderling	2800	11144												13944
Baird's Sandpiper	3360	13373												16733
Semipalmated Sandpiper	700	2790										100		3590
Stilt Sandpiper		21										800		821
White-rumped Sandpiper	65	140										200		405
Willet								9		11	18	16	36	90
Shorebird - large								20	13		15	6	15	69
Shorebird - small/medium								10	5	185	93		53	346
Shorebird - unidentified	5	134	3910	8906	1160	4700	7500	221	256	388	148	140	173	27641
TOTAL	7000	27900	3910	8908	1160	4700	7501	311	334	694	353	1331	290	64392

Table 2. Significant shorebird data from proposed Regional Reserves in Alberta, Saskatchewan, and Manitoba.

Site	Species	No. Birds	Date	Other Information
Beaverhill Lake, Alta.	Shorebirds	23,442	1989	CWS/BBO ground surveys
	Red-necked Phalarope	7000	09/09/89	CWS/BBO ground surveys
	Buff-breasted Sandpiper	700	25/05/83	Cuthiell(1983)
			28/05/84	Gollop (1984)
Cipher lake, Alta.	Shorebirds	5000	25/07/87	CWS ground surveys
	Shorebirds	10,021	1989	CWS ground surveys
Chappice Lake, Alta.	Shorebirds	10,992	1988	CWS aerial & ground surveys
	Sanderling	4500	1988	CWS spring ground surveys = 4.6% of SAPCWP of 98,165 (Morrison and Ross 1989)
Gooseberry Lake, Alta.	Shorebirds	10,765	1987	CWS aerial & ground surveys
		13,503	1988	CWS aerial & ground surveys
		14,719	1989	CWS ground surveys
	Red-necked Phalarope	10,000	1987	Fall CWS ground surveys
	Red-necked Phalarope	7,500	1987	Spring CWS ground surveys
Gillespie Lake, Alta.	Shorebirds	16,854	1988	Spring CWS ground surveys
	Stilt Sandpiper	10,000	21/05/88	CWS ground surveys
Killarney/Leane Lakes, Alta.	Red-necked Phalarope	20,000	25/05/89	CWS ground survey
	Shorebirds	27,542	1989	CWS ground surveys

cont.

Table 2. cont.

Kimiwan Lake, Alta.	Shorebirds	27,067	1988	CWS aerial & ground surveys
	Dowitcher	12,000	1988	Spring CWS ground surveys
Metiskow Lake, Alta.	Shorebirds	17,703	1988	CWS ground surveys
	Baird's Sandpiper	10,000	21/05/88	CWS ground surveys
	Shorebirds	13,487	1989	CWS ground surveys
Reflex Lakes, Alta.	Shorebirds	35,948	1989	CWS ground surveys
	Sanderling	20,000	27/05/89	20.4% of SAPCWP of 98,165 (Morrison and Ross 1989)
	Piping Plover	26	04/05/85	Wershler (1987)
	Piping Plover	38	17/05/86	Wershler (1987)
	Piping Plover	21	1989	CWS ground surveys
Sounding Lakes, Alta.	Shorebirds	55,803	1987	Maximum count, CWS surveys
	Lesser Yellowlegs	11,480	1987	CWS ground surveys
	Yellowlegs	13,532	1987	Spring CWS ground surveys = 14.9% of SAPCWP of 91,047 (Morrison and Ross 1989)
	American Avocet	900	1987	Fall CWS ground surveys
Sullivan Lake, Alta.	Shorebirds	14,130	1989	Maximum count, CWS surveys
Churchill area, Man.	Ruddy Turnstone	6,000	05/06/82	Gollop (1982) = 25.5% of SAPCWP of 23,499 (Morrison and Ross 1989)
	Ruddy Turnstone	+2,000	17/06/83	Gollop (1983) = 8.5% of SAPCWP of 23,499 (Morrison and Ross 1989) Important nesting area for many species including Hudsonian Godwit (Skeel 1976, 1983, Hagar 1966)
Oak Hammock Marsh, Man.	Hudsonian Godwit	+600	1983(ISS)	ISS = 4.7% of SAPCWP of 12,813 (Morrison and Ross 1989)
	Yellowlegs	5,400	29/07/76	(Gardner 1981) = 5.9% of SAPCWP of 91,047 (Morrison and Ross 1989)
	Short-billed Dowitcher	+5,000	1983	ISS= 10.2% of SAPCWP of 48,859 (Morrison and Ross 1989)
	Red-backed Sandpiper	2,200	1983	ISS
	White-rumped Sandpiper	17,645	1981(ISS)	Maximum count on ISS
		17,152	1983(ISS)	Maximum count on ISS
Shoal Lakes, Man.	Piping Plover	70	1989	Koonz, W. unpublished data; West Shoal Lake only
	Piping Plover	82	1985	(Haig and Oring 1988) = 3.1% Great Plains population (2652) (Haig et al. 1988).
Whitewater Lake, Man.	White-rumped Sandpiper	23,068	1987	One day count (Smith and Dickson 1989).
Blaine Lakes, Sask.	Sanderling	10,000	18/05/89	CWS ground surveys = 10.2% of SAPCWP of 111,815 (Morrison and Ross 1989)
	Shorebird	28,961	1989	Maximum count, CWS surveys

Table 2. cont.

Buffer Lake, Sask.	Shorebirds	10,672	1987	One day count (Smith and Dickson 1989).
Killsquaw Lake, Sask.	Shorebirds	7,259	1987	One day count (Smith and Dickson 1989).
Kutawagon Lake, Sask.	Shorebirds	5,654	1987	One day count (Smith and Dickson 1989).
Lac Lenore, Sask.	Shorebirds	12,228	1988	One day count survey
	Shorebirds	25,000	1989	Maximum count, CWS surveys
Lake Diefenbaker, Sask.	Piping Plover	223	1984	Harris et al. (1985) = 8.4% of Great Plains population (2,652) (Haig et al. 1988).
Landis Lake, Sask.	Shorebirds	24,790	22/05/89	One day count, CWS surveys
Last Mountain Lake, (north end), Sask.	Red Knot & Ruddy Turnstone	5,000	21/05/72	= 10.6% of Ruddy Turnstone SAPCWP or 5.1% of Red Knot SAPCWP based on 2,500 of each species. (Morrison and Ross 1989)
	Marbled Godwit	1,000	31/08/65	(Hatch 1966)
Manito/Wells Lakes, Sask.	Shorebird	28,702	1987	One day count (Smith and Dickson 1989)
	Shorebird	36,847	20/05/89	One day count, CWS survey
	Red-necked Phalarope	34,245	20/05/89	CWS ground survey
Middle Lake, Sask.	Shorebirds	10,282	30/05/88	One day count, CWS survey
		12,623	1989	Maximum count, CWS survey
Muddy Lake, Sask.	Shorebirds	10,654	1987	One day count (Smith and Dickson 1989).
Opuntia Lake, Sask.	Shorebirds	5,791	1988	Spring CWS aerial survey
Pelican Lake, Sask.	Shorebirds	+75,000	20/05/78	Maximum count (Serr 1978)
Porter Lake, Sask.	Hudsonian Godwit	1979	1979	O'Neil (1979) = 15.4% of SAPCWP of 12 813 (Morrison and Ross 1989)
	Hudsonian Godwit	1,150	09/07/73	(Harris 1974)
Reed Lake, Sask.	Shorebirds	6,603	24/05/87	One day count, survey (Smith and Dickson 1989).
	Shorebirds	5,960	20/05/85	Maximum count (Gollop 1985)

Table 3. Shorebirds banded at Little Quill Lake, Saskatchewan in 1988 and 1989.

	# BANDED IN EACH YEAR	
SPECIES	1988	1989
American Avocet	1	
Baird's Sandpiper	3	
Greater Yellowlegs	3	
Hudsonian Godwit	101	1
Long-billed Dowitcher	10	4
Least Sandpiper	19	44
Lesser Yellowlegs	46	46
Marbled Godwit	10	6
Pectoral Sandpiper	3	5
Piping Plover	2	2
Red-necked Phalarope	6	
Sanderling	41	
Short-billed Dowitcher	5	1
Semipalmated Plover	38	2
Semipalmated Sandpiper	945	237
Stilt Sandpiper	236	13
Willet	6	7
Wilson's Phalarope	5	3
Dowitcher spp.		3
Killdeer		2
Spotted Sandpiper		2
Western Sandpiper		1
White-rumped Sandpiper	1	
TOTAL BANDED	1481	379

THE FUTURE

Over the next 3 years, CWS will be concentrating its shorebird efforts at Quill Lakes in Saskatchewan. Continued banding efforts, detailed shorebird surveys of the Quill Lakes shoreline and the small basin associated with the lakes, invertebrate sampling and water chemistry testing will be the main thrust of the program. This work will provide valuable data relevant to the Quill Lakes and will result in recommendations to ensure that habitat protection or enhancement for shorebirds is accomplished through the NAWMP. In addition, other data relevant to shorebirds at wetlands of importance throughout prairie Canada will be acquired: this would define turnover rates of migratory shorebird species during both migration periods; shorebird food requirements on prairie wetlands; time-budgeting factors; and migration route information to name a few.

Future shorebird programs are being developed to begin looking at prairie nesting species such as the American Avocet, Wilson's Phalarope, Willet (*Catoptrophorus semipalmatus*), and Marbled Godwit (*Limosa fedoa*). Definition of major nesting areas, population limits, and habitat requirements of the various species are but a few of the issues which need to be addressed. Work will also be undertaken on the arctic nesting grounds of shorebirds which only pause in prairie Canada during migration. Defining linkages between prairie staging sites, breeding grounds, and wintering grounds of shorebirds would be extremely beneficial to the future protection and management of western hemisphere shorebird populations.

Table 4. Banded bird sightings or recaptures related to the Canadian Wildlife Service Prairie Shorebird Banding Program, 1987 to 1989.

	Banded		Sighted or Recaptured	
Species	Where	When	Where	When
SLSA	LQL[1]	15/07-20/08/88	Aransas WF, Texas	30/08/88
SESA	Araya Peninsula, Venezuela	03/03/85	LQL (recaptured) Band #811-1027	05/08/88
SESA	LQL	15/07-20/08/88	Scarboro, Maine	29/08/88
SESA	LQL	15/07-20/08/88	Aruba, Netherlands	17/09/88
SESA	LQL	10/07-15/08/88	Jackson, SC	23/08/89
SESA	Peru	??	Opuntia Lake, Sask.	17/05/89
SESA	Cheyenne Bottoms, Kansas	08/05/85	LQL (recaptured) Band #1401-25179	03/08/89
HUGO	LQL	15/07-20/08/88	LMLNWA[2]	30/07/89
MAGO	LQL	15/07-20/08/88	Duck Creek Marsh, Sask.	20/08/88

[1] LQL=Little Quill Lake, Saskatchewan

[2] LMLNWA=Last Mountain Lake National Wildlife Area, Saskatchewan

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ACTION PLAN FOR CONSERVING PIPING PLOVERS IN PRAIRIE CANADA

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Strategies for conserving the Piping Plover (*Charadrius melodus*) have been primarily addressed during this past decade. National recovery plans have recently been published for the United States (Dyer et al. 1988, Haig et al. 1988) while publication of the Canadian Piping Plover Recovery Plan (Atlantic and Prairie Piping Plover Recovery Teams in prep.), approved in 1989, is forthcoming.

Responsibility for Piping Plover conservation in Canada lies with a national coordinator and two regional recovery teams - the Atlantic Piping Plover Recovery Team (APPRT) and the Prairie Piping Plover Recovery Team (PPPRT). Provincial wildlife agencies, also members of the recovery teams, individually plan recovery efforts within their own jurisdictions. A recovery or management plan has been drafted in several provinces. The PPPRT is responsible for Piping Plovers in Ontario, Manitoba, Saskatchewan, and Alberta while the APPRT is responsible for plovers in Quebec and the Atlantic provinces. Each of the teams have identified specific actions which would lead toward benefiting the plover's survival within their jurisdiction. These tasks have been incorporated into the national plan as part of the recovery implementation schedules. The following actions are stated in a draft of the national plan (Atlantic and Prairie Piping Plover Recovery Teams in prep.) as part of the Prairie Canada Piping Plover population implementation schedule:

Research And Surveys - (1) Monitor populations and productivity annually at specific sites. (2) Determine plover distribution in Prairie Canada. (3) Determine effect of habitat and its influence on productivity. (4) Participate in international survey of breeding and wintering grounds.

Management - (1) Identify essential habitats and protection/management needs required for specific sites. (2) Monitoring use of managed habitats.

Administration And Public Education - (1) Develop communications and education programs. (2) Develop enforcement programs.

An overview of Canadian conservation and research activities, which principally covers the period of 1985-1988, documents measures taken in Prairie Canada to learn more about the distribution, abundance, and biology of the plover as well as explore conservation approaches (Goossen in prep.). These efforts have provided background information and serve as a foundation on which the action plans can stand. Several recent projects have contributed to the above tasks during 1989. With regard to surveys, counts were made in Ontario (Lambert and Risley 1989), Manitoba (Koonz 1989), Saskatchewan (Harris, Lamont, and Sequin 1989), Alberta (Goossen unpubl. data, Wershler 1989). Most of the priority sites identified by the PPPRT were surveyed. This is the first year that Piping Plover pair and production surveys were carried out in various areas in Prairie Canada during a relatively standardized time frame. Should these surveys continue over the long-term, they will provide information on baseline population data which will enable biologists to detect population changes which may signal a reconsideration of the plover's status or influence management effort.

Distribution surveys at Lake of the Woods, Ontario (Lambert and Risley 1989), along the North Saskatchewan River, and on south-central lakes in Saskatchewan (Johnson and Sequin 1989) resulted in no (Lake of the Woods) and little success (Saskatchewan) in finding plovers. In Alberta, a previously unknown breeding area at Killarney Lake was located (Wershler 1989). Additional distribution surveys in Saskatchewan during 1990 will further illuminate the distribution of this species in this province and will aid in the planning for the 1991 international Piping Plover survey.

In terms of management, the PPPRT affirmed in 1988 that natural breeding sites would be preferred for Piping Plovers over modified sites. Only four sites in Prairie Canada have been altered to encourage use by Piping Plovers. At one of these sites, Little Quill Lake, plovers were seen this past year however, there was no evidence of nesting (D. Hjertaas in litt.).

The recent publication of a Canadian Wildlife Service Who's Who (Goossen 1989) and the forthcoming pamphlet on the Piping Plover in Alberta by the Alberta Fish and Wildlife (in prep.) will serve as source information on the plover to the general public.

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CONSERVATION MANAGEMENT OF PIPING PLOVERS IN NORTH DAKOTA

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ABSTRACT

In December 1985, the Piping Plover (*Charadrius melodus*) was listed as a federally Threatened and Endangered species. Habitat use and population biology of Piping Plovers was studied from 1984 - 1987 at John E. Williams Memorial Preserve (JWMP), owned and managed by The Nature Conservancy, McLean Co., North Dakota in an effort to yield data useful for conservation management of this species. Data on habitat use and reproductive success in 1984 and 1985 has been published (Gaines, E. P. and M. R. Ryan 1988. Piping plover habitat use and reproductive success in North Dakota. J. Wildl. Management 52:266-273).

Analysis of habitat use information indicated that plovers were significantly more successful when nesting on territories with little vegetative cover and on territories with highly clumped vegetation. Plover nests on gravel beaches were more likely to hatch than plover nests on alkali beaches. Also, beach width at territories was significantly greater than at unoccupied sites.

Minimum adult annual mortality, calculated from resightings of colour-banded adults, was estimated at 0.64. We monitored reproductive success of 46 pairs of nesting Piping Plovers in 1984, 91 pairs in 1985, 131 pairs in 1986, and 152 pairs in 1987. Mayfield nest success rates were 41% in 1984, 42% in 1985, 37% in 1986, and 51% in 1987. Approximately 90% of annual egg losses were due to predators. Mammalian and avian predators were suspected in the losses of 65% and 35% of total egg losses, respectively. Fledging rates were 1.48 chicks fledged/pair of breeding piping plovers in 1984, 1.04/pair in 1985, and 0.63/pair in 1986, and 0.69/pair in 1987.

Population growth rates calculated from our estimates of annual adult survival and estimates of juvenile survival taken from published literature indicate that the population level of Piping Plovers at JWMP is slowly declining. Habitat and predation appear to limit this population.

Using our information on population dynamics and on habitat selection, we proceeded with a combination of conservation strategies to manage for Piping Plovers at JWMP. These strategies are intended to be of use for plovers nesting on alkali wetland elsewhere in the U.S. and Canada.

The first strategy involved control of predators. Electric predator-fences were constructed at 4 sites in 1986 to test their efficacy to increase productivity and juvenile recruitment. Data on use and results of fences is published (Mayer, P. M. and M. R. Ryan. 1991. Electric fences reduce mammalian predation on Piping Plover nests and chicks. Wildl. Soc. Bull. 19:000-000).

Mean nest survival at fenced beaches was 70% higher than at unfenced beaches ($t = 2.31$, 52 df, $P = 0.025$). Mean chick survival at fenced beaches was increased by 55% over that at unfenced beaches ($t = 1.8$, 52 df, $P = 0.077$). Mean number of chicks fledged/par of the breeding Piping Plovers was higher inside the fences ($t = 2.0$, 52 df, $P = 0.051$) than at unfenced beaches.

The second strategy involved creating additional and enhancing existing Piping Plover nesting habitat. In 1985, we tested the efficacy of 4 vegetation-eradication treatments on 2 x 2 meter plots at Audubon National Wildlife Refuge, McLean Co., North Dakota. A killdeer nested on a plot treated with gravel. None of the other 3 treatments appeared to be effective in creating nesting habitat.

Additional, integrated conservation strategies for Piping Plovers in North Dakota are described elsewhere in this Proceedings by K. A. Smith, R. L. Kriel, and P. J. Dryer.

EXPERIMENTAL MANAGEMENT OF PIPING PLOVER HABITAT AT LOSTWOOD NATIONAL WILDLIFE REFUGE, NORTH DAKOTA

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ABSTRACT

Management of Piping Plovers (*Charadrius melodus*) on the 105 km^2 Lostwood National Wildlife Refuge in northwestern North Dakota includes (1) monitoring numbers of adults and success of breeding pairs, (2) experimental and manipulation of habitat using grazing, prescribed burning, salt application on shoreline vegetation, gravel and cobble additions to shorelines and predator enclosures and (3) evaluating nest area parameters including water chemistry. During 1984 to 1988, six to 18 pairs occupied nesting territories on seven wetlands ranging in size from 7 to 211 ha. Cattle appeared to displace Piping Plovers during the nesting period, but litter removal via grazing subsequently benefitted plovers. Breeding pairs were attracted to shorelines after prescribed burning, also probably due to litter removal. Fencing decreased mammalian predation but on some areas, increased gull (*Larus* spp.) problems were experienced except when nesting American Avocets (*Recurvirostra americana*) were present. Wetland saltwater and rock salt applications to retard plant growth at nesting sites is in experimental stages. An increase of Piping Plovers may be due in part to habitat management employed. We are submitting a manuscript to "The Prairie Naturalist", published by The North Dakota Natural Science Society.

PIPING PLOVER HABITAT PROTECTION THROUGH THE NORTH DAKOTA NATURAL AREAS REGISTRY PROGRAM

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The recovery efforts of Piping Plovers (*Charadrius melodus*) in North Dakota include inventory, research, protection, and management. The North Dakota Natural Areas Registry Program, a cooperative venture of the North Dakota Parks and Recreation Department and the North Dakota Chapter of the Nature Conservancy, contributes to recovery efforts through habitat protection. This paper describes how the Natural Areas Registry works and discusses the purposes of the Registry, which are to: 1) educate landowners about Piping Plover use on their property; 2) ask landowners to voluntarily protect their Piping Plover habitat; and 3) formally recognize landowners who enter the program.

In North Dakota, populations of Piping Plovers are contained in two primary areas: sandbars of the free-flowing stretch of the Missouri River and saline lakes in the prairie pothole region of central North Dakota. Missouri River sandbars are state-owned, however, over one-half of the saline lakes are privately owned. Therefore, it is important to develop a landowner contact program to ensure that Piping Plover habitat is protected on privately owned land. Also, land acquisition by government agencies in North Dakota seldom occurs, so voluntary landowner protection of these habitats is critical.

The Natural Areas Registry Program begins with the identification of significant natural areas. Information on Piping Plover sites is turned over to personnel who contact landowners to notify them of the significant Piping Plover habitat on their property and to ask landowners to voluntarily protect the habitat they own. If the landowners agree to this voluntary protection, they are given a plaque and certificate signed by the Governor of North Dakota. If they prefer, landowners are awarded their plaque and certificate at a special ceremony attended by the Governor, local legislators, state officials, and news media.

To date, thirteen landowners on eight saline lakes in North Dakota have voluntarily agreed to protect their Piping Plover habitat. The lakes under this program contained 25% and 20% of the North Dakota breeding pairs in 1987 and 1988, respectively.

In addition to protecting habitat, the Natural Areas Registry Program also is important for educational purposes. News releases are prepared and sent, with photographs, to local newspapers. In addition, local legislators and government officials are invited to ceremonies so they can witness the landowner commitment and learn about Piping Plovers. The North Dakota Parks and Recreation Department and the Naure Conservancy produce a bi-yearly newsletter which is sent to all landowners, agency decision makers, local legislators, and to the Governor's office to keep them informed of the program's objectives and of significant natural areas in North Dakota.

The important question to ask when implementing a program such as this is: "Does the program protect Piping Plover habitat?" In the case of North Dakota, the plover habitat is temporarily protected through these landowner agreements. At the very least, the habitat will be protected from inadvertent destruction by landowners who were unaware of the land's value to Piping Plovers. Another question to ask is: "Does this program guarantee the long-term survival and recovery of Piping Plovers?" In the case of North Dakota, the answer to this question is, not without additional management and long-term protection. When dealing with endangered or threatened species, it is often necessary to implement other management or recovery tactics to insure the species long-term survival. Since the protection offered through voluntary agreements is somewhat tenuous, it also is important to make sure that these sites fit into a long-term conservation plan that addresses national recovery objectives.

Many positive aspects have come out of the Natural Areas Registry Program, such as landowner education, landowner cooperation, decision-maker education, and some degree of habitat protection. A program such as this is positive for the agency or organization implementing it. In addition, the Registry Program "buys time" for these habitats until recovery objectives determine the best use and management of these sites. Additional management agreements and long-term protection of these sites should be considered to enhance species productivity and contribute to Piping Plover recovery.

A MANAGEMENT STRATEGY FOR MOUNTAIN PLOVERS IN ALBERTA

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In 1979, the first nesting of the Mountain Plover (*Charadrius montanus*) was documented for Canada, in the Lost River area of Alberta. During nine years following this discovery, Mountain Plovers have shown fidelity to a relatively small area of mixed grassland habitat at Lost River, and numerous nests and broods have been documented.

The nesting population has remained very small, ranging from a high of 11 adults and 6 nests in 1981 to a low of no birds in 1987. Actual nesting habitat comprises less than two square miles (518 hectares). Approximately 18 square miles (4,662 hectares) of similar habitat with nesting potential exists adjacent to this traditional nesting area. Nesting habitat is heavily grazed or recently burned and grazed native grassland occurring on fine sandy loam on glacial outwash deposits.

Historic records indicate that Mountain Plovers were probably more abundant in late 1800s in an area along the forty-ninth parallel, including southeastern Alberta and northern Montana (Coues 1878). The Mountain Plover is at the edge of its range in Alberta and, due to habitat destruction through cultivation, is isolated from major populations farther south. This may be a contributing factor to the species' rarity. However, there is a sufficiently large potential habitat base remaining in the Milk River-Lost River area of Alberta, and it appears that the size of the nesting population is being limited by current grassland management. This is generally inappropriate for the creation of suitable nesting habitat (Wershler 1987; Wershler and Wallis 1986).

Overall, it is recommended that management be undertaken to increase the breeding population of Mountain Plovers through the creation of additional suitable nesting habitat, maximization of the potential of existing nesting habitat, and protection of nesting birds. To accomplish this, it will be necessary to adopt a more holistic, flexible approach to grassland management.

HABITAT CREATION AND IMPROVEMENT

The majority of grassland in the area is lightly to moderately grazed. Only a small percentage of the potential habitat receives sufficiently heavy and intensive grazing to maintain the short grass cover required by nesting Mountain Plovers.

Recommendations:

1. A variety of grazing regimes which produce heavily grazed habitat should be tested, in order to determine which are most compatible with creating and maintaining Mountain Plover nesting habitat.

2. Traditionally heavily grazed areas should be carefully monitored for changes in the natural habitat which would make it unsuitable for nesting Mountain Plovers.

3. The combination of recent fire and light grazing appears to be able to produce habitat features similar to those created by repeated heavy grazing. A review of the effects of fire on plant species which are the major constituents of Mountain Plover nesting habitat in Alberta shows that these species are generally tolerant of fire (USDA-BLM 1988). Prescribed burning, combined with various grazing strategies, should be experimented with as a tool for the creation of Mountain Plover nesting habitat. Priority should be given to potential nesting habitat adjacent to traditional nesting habitat, but some work should also be done in marginal habitats.

4. Burning should take place in late summer or early fall to coincide with the season when fires initiated by lightning strikes occur in the region. This is also the time of year when the major plant species in Mountain Plover nesting habitat are most fire-resistant. Prescribed burns should be carefully planned for safety and efficiency.

5. In north-central Montana, Mountain Plovers nest in Black-tailed Prairie Dog (*Cynomys ludovicianus*) towns which are also grazed by cattle. Prairie dogs appear to create suitable Mountain Plover nesting habitat in otherwise marginal or unsuitable habitat by maintaining the shortness of the vegetation and limiting the growth of sagebrush. It is possible that in the past Richardson's Ground Squirrels (*Spermophilus richardsonii*), interacting with Bison (*Bison bison*), climate and fires, may have been responsible for habitat features which were beneficial to nesting Mountain Plovers.

In the Milk River-Lost River region, Richardson's Ground Squirrels have experienced significant declines in populations compared to the late 1800s when the species was apparently abundant (Cutright and Brodhead 1981). In the past few years, ground squirrels have increased in numbers along the northern fringe of the region and have been moving closer to the traditional Mountain Plover nesting area. Ground squirrel control, still a common practice in the region, should be discontinued on Crown lands in the Milk River-Lost River region.

The Richardson's Ground Squirrel, considered a pest, is also an important component of the grassland ecosystem. It is interconnected in complex ways with other features of the grassland. Grassland management should recognize these relationships; the Richardson's Ground Squirrel is an essential element of the habitat of numerous species of animals, including threatened species.

PROTECTION OF NESTING HABITAT

One of the greatest threats to Mountain Plovers is habitat destruction. In the Lost River area, two to three square miles (780 hectares) of once potential habitat have been planted to exotic forage crops. Although there was a nesting record in 1988 in a field that had been planted to Russian wild rye in the 1960s, Mountain Plovers have generally avoided cultivated areas. Graul (1980) reports that the species is intolerant of cultivation.

Recommendation:

Further cultivation of native grassland on Crown lands within the known range of the Mountain Plover in Alberta should be prohibited.

PROTECTION OF NESTING BIRDS

The use of motor vehicles for range patrol and supplemental feeding has created a network of trails through the traditional Mountain Plover nesting area. In addition, off-road driving has resulted in vehicle tracks in documented and potential nesting habitat. Repeated, concentrated driving through a portion of the traditional nesting habitat has severely impacted the native vegetation. Uncontrolled public access and an increase in numbers of visitors to the area has increased motor vehicle traffic.

Recommendations:

1. A designated vehicle route plan should be formulated for all users in order to limit the amount of off-road travel. The plan could incorporate a system of visitor registration.

2. If the nesting population of Mountain Plovers remains very low, controls should be considered on visitor access during key times during the nesting season - April to early July.

3. To prevent further incursions of non-native plants into the nesting habitat, feeding stations should be limited to specific areas instead of the widespread placing of feed which has been done in the past. A feed storage area which currently is located in a traditional nesting field should be relocated or, at the very least, further expansion of the site and disturbance to the grassland should be curtailed. In the future, this sort of activity should be restricted to disturbed areas of less significant natural habitats.

4. There should be a review of current range management practices, including methods of range patrol, and the pros and cons of supplemental feeding in native rangelands. Serious consideration should be given to limiting the majority of supplemental feeding to cultivated or "improved" areas.

INFORMATION AND EDUCATION

The success of any management program for the recovery of the Mountain Plover depends on the education and support of the various landholders and user groups.

Recommendations:

1. A program of visitor education should be implemented to complement the designated route plan. Educational materials, including brochures and signage, would highlight the significance and sensitivity of the Mountain Plover as well as other special features of the area.

2. The creation of a "wanted" poster for distribution to pasture managers, post offices, and local residents would help to create interest in the plight of the Mountain Plover and would encourage people to report sightings.

3. Meetings between landholders in the Milk River-Lost River region and appropriate government agencies should be held in order to inform ranchers and land managers about the status of the Mountain Plover and other rare features of wildlife in the area, and how habitat diversity can be achieved with minor adjustments to present range management practices. Plans for conservation and management programs could be discussed and the landholders updated on their progress and results.

MISCELLANEOUS RECOMMENDATIONS

The large majority of known and potential nesting habitat in the Lost River-Milk River region is located on Crown land. All of the traditional nesting habitat is leased to Agriculture Canada; it also forms a part of a candidate Natural Area.

1. Populations and nesting success of Mountain Plovers should be monitored yearly in the initial phase of the management program.

2. More information should be collected on habitats used before and after the nesting season.

3. If the population of nesting birds is gradually built up, a banding program should be considered in order to investigate possible relationships of the Alberta population with populations in Montana and Saskatchewan. It may also provide information on wintering areas.

4. Release of Montana birds into Alberta should also be considered, once habitat requirements in Alberta are better understood.

5. Management of the traditional nesting habitat should be a cooperative program involving Alberta Fish and Wildlife, the Alberta Natural Areas Program, and the leaseholder - Agriculture Canada. A working group for the Lost River area could aid in the development of a management plan and for reviewing proposed developments and land use changes. A cooperative funding arrangement should be explored, whereby the Alberta Government, with assistance from federal agencies and non-profit conservation groups like World Wildlife Fund Canada, would provide support for ecological research and development of educational materials.

6. The Alberta management plan should serve as a pilot program for Mountain Plover conservation work in Saskatchewan.

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EFFECTS OF FLUCTUATING WETLAND CONDITIONS ON PRAIRIE SHOREBIRDS

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ABSTRACT

Conservation plans for prairie shorebirds require detailed knowledge of the distribution and abundance of species under varying environmental conditions. I examined the effects of annual and seasonal changes in wetland habitat on breeding and migrating shorebird assemblages at Last Mountain Lake National Wildlife Area, Saskatchewan. Breeding communities were strongly affected by annual changes in wetlands. Species number and total shorebirds declined with increasing wetland desiccation. Return rates varied greatly among species indicating that fluctuating wetland conditions affect taxa differently. Some individuals returned to ephemeral wetlands in the absence of drought conditions. Seasonal changes in wetlands influenced choice of nesting and brooding sites by Wilson's Phalarope (*Phalaropus tricolor*). Shorebird assemblages at 26 sites differed markedly between 1983, a year in which wetlands held ample water, and 1984, a drought year. Inter-year comparisons revealed that ephemeral sites had significantly fewer species and lower numbers of shorebirds compared with permanent sites. Manipulation of water levels at an artificial impoundment during spring 1985 strongly affected shorebird assemblages. Shorebird diversity was reduced when habitat diversity was low. Together, these patterns indicate that management of prairie shorebird populations requires a greater understanding of the ecology and behavior of shorebirds within seasonally and annually fluctuating wetland ecosystems.

INTRODUCTION

Conservation efforts emphasizing habitat management rely on a firm understanding of the ecology and behavior of species in association with spatial and temporal patterns of distribution and abundance. Shorebird conservation schemes, including the establishment of an international reserve network with key sites along migratory corridors (Morrison and Myers 1987), have been the vanguard of endeavors that seek to thwart species declines. The establishment of the reserve network stemmed from ongoing international research efforts, during which scientists gained crucial knowledge of species' migration ecology. For example, enough was known of the timing and path of migration, site-faithfulness, and food resources used by species such as Red Knot (*Calidris canutus*); (Harrington et al. 1988) to set aside sanctuaries at several key points along the Atlantic seaboard (Myers et al. 1987).

By contrast, much less is known of the behavior and ecology of shorebirds that breed and migrate throughout prairie wetlands of North America (Morrison and Myers 1987). Our ignorance is brought into sharp focus when we survey the importance of this region for Nearctic shorebirds and the potential impact of habitat loss on maintenance of viable populations. Approximately one-fifth of wader species breeding in the Nearctic reside at prairie wetlands. Moreover, the breeding distributions of species such as the Piping Plover (*Charadrius melodus*), Marbled Godwit (*Limosa fedoa*), and Wilson's Phalarope (*Phalaropus tricolor*) lie largely within the region, indicating that conservation efforts directed at these species may be particularly important. In addition, most wader species recorded in North America use prairie habitat at some time during their annual cycle. Although many of these species utilize migration corridors that encompass both coastal and interior wetlands, a large proportion of the populations of some species concentrate at prairie sites during north and southbound migration and may be susceptible to habitat alterations.

In this paper, I assess the impact of annual and seasonal variation in wetland habitat on prairie shorebirds, emphasizing key areas of research that might benefit most our understanding of prairie shorebird ecology. Results are divided into three sections: (1) changes in communities of breeding shorebirds associated with seasonal and annual fluctuations in wetland conditions, (2) patterns of shorebird distribution at 26 wetlands during wet and dry years, and (3) effects of water level manipulation on spring shorebird assemblages. Lastly, I discuss implications of these findings for the prairie conservation plan.

METHODS

I studied shorebirds at Last Mountain Lake National Wildlife Area in south-central Saskatchewan (51° 10'N; 110° 2'W) from 1982 to 1987. Set aside over a century ago as a haven for migratory birds (Hendry 1987), the refuge encompasses a diversity of habitats including prairie, lakeshore, marsh, and an array of wetlands. During the 6 years I studied shorebirds, wetland conditions varied considerably, ranging from drought conditions in 1984 when approximately 90% of local wetlands were dry, to conditions of ample water in wetlands.

The shorebird community of Last Mountain Lake is particularly rich (Colwell 1987). Thirty-four species have been observed (Dale 1987) including nine that breed locally and 25 that use refuge habitat during migration to and from boreal and arctic breeding grounds (Colwell 1987, Colwell and Oring 1988a).

I studied shorebird communities at a number of sites located on and adjacent to the refuge (Fig. 1). Breeding shorebirds were studied at two principal sites, Lanigan Creek (site 1) and East Alkaline Lake (site 2). Shorebird communities also were surveyed at 29 sites refuge-wide during 1983 and 1984; 26 of these sites

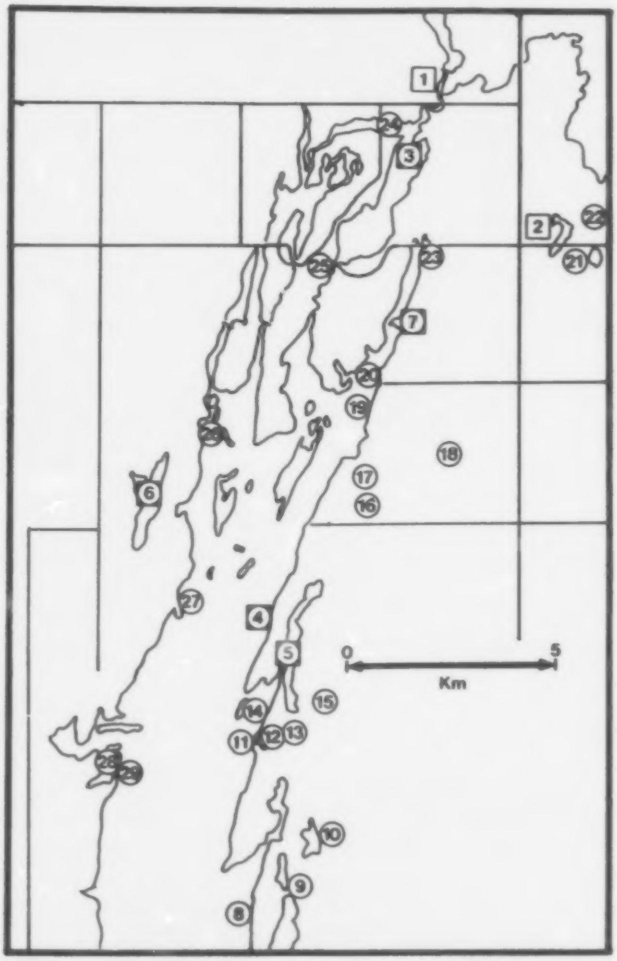

Figure 1. Location of study areas at Last Mountain Lake National Wildlife Area, Saskatchewan.

were censused in both years, providing comparative data. Finally, during 1985 I manipulated water levels at Basin A (site 3), a man-made impoundment. Details of study sites are presented elsewhere (Colwell and Oring 1988a,b,c). Data presented here are of several types: species richness, total shorebirds, average birds per census, and Shannon diversity indices (Magurran 1988). Data are presented as mean ± standard deviation.

RESULTS

Breeding Communities

The breeding community of shorebirds at East Alkaline Lake was dramatically altered by annual variation in wetland conditions (Fig. 2). Overall, six species nested at the site and five occurred at densities that allowed assessment of annual population changes. In 1982, a year in which the wetland held water throughout the breeding season, shorebird numbers ranged from 45+ male Wilson's Phalaropes to three Willets (*Catoptrophorus semipalmatus*). Numbers of all species declined in 1983, a year in which the wetland dried up in early June. In 1984, a drought year in which the wetland never held water, no shorebirds bred. The wetland was full again in 1985 and numbers of all species rebounded. Changes in shorebird numbers at Basin A also resulted from annual variation in water levels. During 1984, drought exposed large expanses of mudflat at the northern reaches of the impoundment which usually was inundated during the breeding season. Approximately 15 pairs of avocets nested at Basin A during 1984; nesting pairs were absent in other years.

Return rates of prairie shorebirds varied widely among species (Fig. 3), ranging from 12% for Wilson's Phalaropes to 100% for Willets. Although interspecific patterns may be associated with a species' social system and longevity of individuals (Colwell and Oring, 1989), they also suggest interspecific variability in susceptibility and response to wetland desiccation. In particular, philopatry of highly aquatic species, such as Wilson's Phalarope, may be strongly influenced by wetland conditions prevailing at the time of return. The return of marked individuals of all species following the absence of a drought year indicates that experience may be important in choice of a breeding site. Some individuals were seen during the drought year at neighboring wetlands (Colwell and Oring 1989).

Seasonal changes in wetland conditions affected breeding shorebirds in more subtle ways. In 1983, local nesting by Wilson's Phalaropes at East Alkaline Lake ended in early June when no water remained in the wetland, but phalaropes continued to initiate clutches for another two weeks at neighboring wetlands that held water (Colwell and Oring 1988a). In addition, some male phalaropes that hatched chicks in early June moved broods more than 1 km over upland habitat to neighboring wetlands. Other species too were affected by unsuitable and changing wetland conditions during spring of 1983. Several pairs of avocets courted at the site but failed to lay eggs.

Shorebird Communities: Wet and Dry Years

During 1983 and 1984, I surveyed shorebirds at 26 wetlands on and adjacent to the wildlife area (Table 1). These two years differed markedly in climate, with ephemeral sites (n=10) dry during 1984. Those sites with permanent water conditions (n=16) were either lakeshore sites (n=13) or wetlands that were supplied by a permanent water source (n=3). Overall, there was no difference between years in the average number of species per wetland (Table 1; 1983, 7.5 ± 5.1; 1984, 9.3 ± 7.9; Mann-Whitney U-test, z=.32, P=0.75).

Between-year comparisons of shorebird assemblages at ephemeral and permanent wetlands revealed a dramatic influence of drought on shorebirds. Sites were compared between years for similarity in species composition, the percent of species in common. The between-year similarity in species composition averaged 13 ± 13% for ephemeral sites, compared with 40 ± 16% similarity for permanent sites. This difference was highly significant (Mann-Whitney U-test, z=3.28, P<0.002). On average, annual changes in species composition differed significantly between ephemeral and permanent sites (Mann-Whitney U-test, z=3.36, P<0.002). Ephemeral sites lost 5.3 ± 7.5 species, whereas permanent sites gained 6.3 ± 5.6 species. Moreover, ephemeral sites experienced a greater between-year decline in shorebird numbers compared to permanent sites (Mann-Whitney U-test, z=3.01, P<0.01). Ephemeral sites lost an average of 59% of shorebirds whereas permanent sites gained 91% in total shorebird numbers.

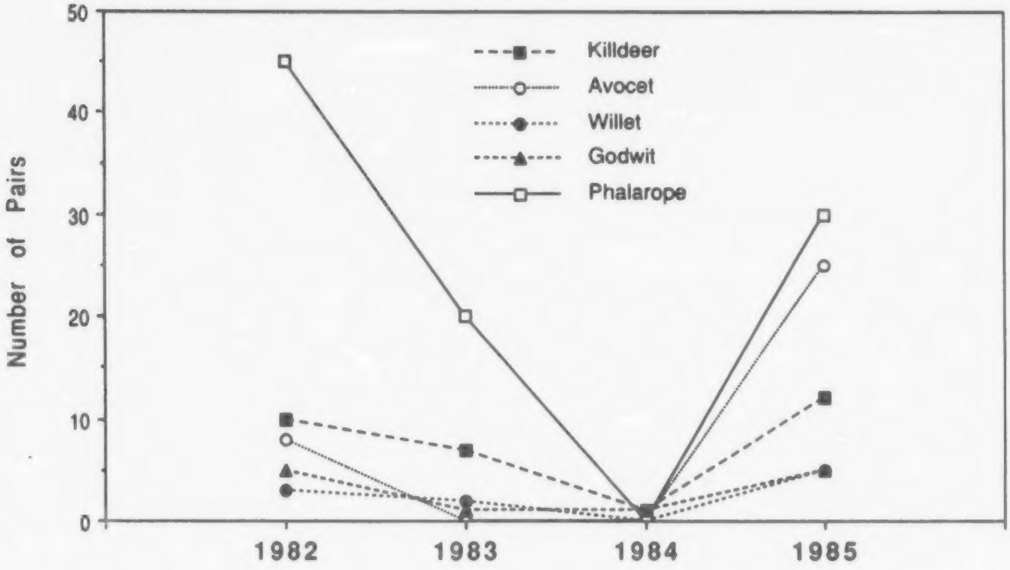

Figure 2. Annual changes in numbers of breeding shorebirds at East Alkaline Lake.

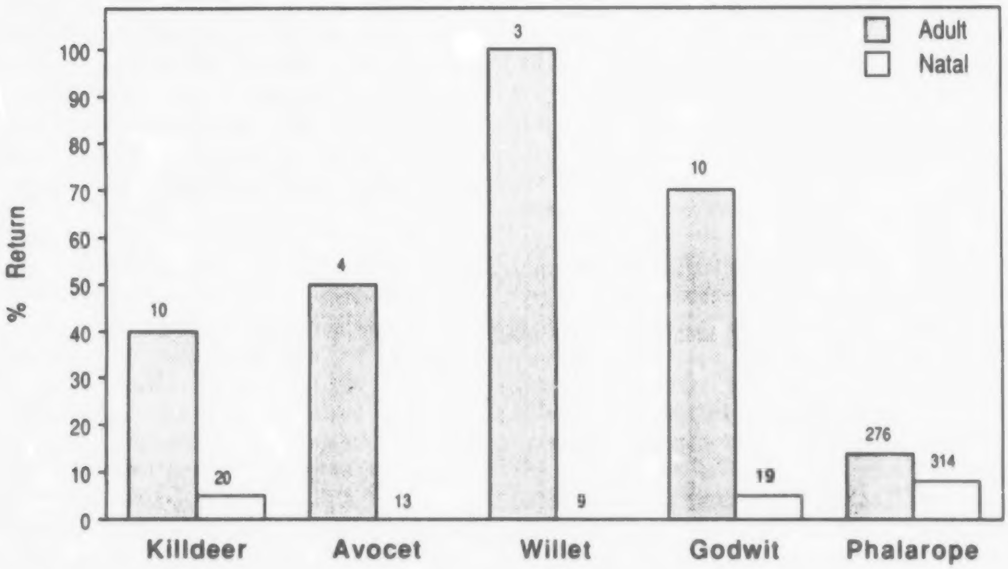

Figure 3. Interspecific differences in return rates of shorebirds to East Alkaline Lake and Lanigan Creek. Sample sizes are shown above histograms.

Table 1. Comparison of shorebird assemblages at permanent and ephemeral wetlands. Numbers designating wetlands correspond to locations shown in Figure 1. Two entries for each wetland correspond to date from wet (1983) and dry (1984) years, respectively.

1. Permanent Wetlands:

	1	4	5	8	11	12	14	19	20	22	23	24	26	27	28	29
Species Richness	12	12	11	11	5	9	1	5	8	13	6	8	3	4	6	5
	25	25	22	16	16	17	8	5	5	10	6	14	8	11	21	10
Number of Individuals	186	102	542	34	7	69	1	10	124	178	18	205	8	15	60	30
	11393	2317	1331	335	150	179	85	26	62	119	21	364	62	112	530	219
x Individuals per Census	93	15	90	34	7	35	1	5	62	89	18	68	8	15	60	15
	50	100	66	42	21	22	11	4	9	17	3	46	8	14	66	27
Shannon Diversity*	.54	.49	.47	.97	.87	.56	.00	.37	.25	.78	.69	.36	.45	.54	.63	.36
	.63	.71	.58	.60	.62	.60	.46	.17	.24	.28	.10	.50	.44	.39	.68	.42
Number of Censuses	2	7	6	1	1	2	1	2	2	2	1	3	1	1	1	2
	227	23	20	8	7	8	8	7	7	7	8	8	8	8	8	8

2. Ephemeral Wetlands:

	2	6	9	10	13	15	16	17	18	21
Species Richness	23	16	4	9	6	3	2	0	3	9
	2	4	1	2	2	1	8	1	1	0
Number of Individuals	6846	1197	14	425	84	16	4	0	21	165
	5	20	3	22	3	1	46	2	3	0
x Individuals per Census	40	109	14	425	84	5	2	0	21	165
	1	3	0	3	0	0	6	0	1	0
Shannon Diversity*	.51	.61	.51	.77	.61	.09	.14	.00	.28	.53
	.05	.12	.00	.20	.04	.00	.17	.00	.00	.00
Number of Censuses	170	11	1	1	1	3	2	2	2	2
	6	8	7	8	7	7	8	7	6	6

*Average Shannon diversity index. Shannon index was calculated as $-\sum P_i \log P_i$, where P_i is the proportion of ith species in the sample (Magurran 1988).

Water Level Manipulations and Shorebird Assemblages

During spring 1985, I assessed changes in the shorebird community associated with manipulated water levels at Basin A (Colwell, in prep.). Patterns are compared against data from 1984, a year when Basin A was not manipulated.

The average number of species using Basin A was significantly greater in 1984 ($x = 9.1 \pm 1.8$) than 1985 ($x = 5.4 \pm 2.6$) (Mann- Whitney U-test: $z = 3.53$, $P < 0.0001$). Overall, the number of species using Basin A was much more variable in 1985 and the changes closely parallel variations in water levels. Low species numbers occurred on 7 May ($n = 1$) and 15 May ($n = 3$), corresponding with periods when water inundated the study area. On 9 June, a low species count ($n = 3$) was associated with very low water levels.

The average number of shorebirds using Basin A also differed significantly (Mann-Whitney U-test; $z = 3.58$, $P<0.0001$) between years (1984, $x = 284 \pm 168$; 1985, $x = 82 \pm 88$). Again, patterns for total shorebirds using Basin A were much more variable in 1985. Declines in shorebird numbers were associated with either high or low water periods.

Shorebird diversity (Shannon diversity index; Magurran 1988) was much more variable in 1985 than 1984. Most comparisons of successive samples were significantly different ($P<0.05$). In 1985, shorebird diversity was lowest during high or low water episodes.

DISCUSSION

Prairie shorebirds are confronted with a unique set of ecological circumstances compared to waders using marine environs. In marine ecosystems, shorebirds depend on predictable food resources to replenish energy stores necessary for over-winter survival and for long-distance migration. Variation in the availability of marine food resources and habitat use is most strongly influenced by diurnal tidal cycles (Burger et al. 1977), although winter food resources are gradually depleted by shorebird predators (Goss-Custard 1980). The relative certainty of resource availability in marine systems has led to strong site-faithfulness among coastal waders [e.g., Red Knots (Harrington et al. 1988)]. By contrast, habitat and underlying food resources for prairie shorebirds are much less predictable, owing largely to seasonal and annual variations in climate.

Changing patterns of prairie shorebirds communities reflect the unpredictability of wetland resources. Numbers of breeding waders fluctuated greatly, especially at ephemeral sites. Interspecific differences in site-faithfulness of banded birds suggest that species differ in response to changing wetland habitat. In addition, seasonal habitat changes affected the reproductive decisions of individual birds, either in choice of sites for nesting or brooding (Colwell and Oring 1988b).

Annual variation in shorebird communities at wetlands and changes in spring shorebird assemblages associated with manipulation of water levels suggests that shorebirds are strongly influenced by habitat availability. The decrease in species numbers and total shorebirds at ephemeral sites during drought periods suggests that birds respond directly to changes in aquatic habitat. During drought episodes birds shift to dependable wetlands, as indicated by the increase in species and birds at permanent wetlands during 1984. In general, these patterns were supported by the response of shorebirds to habitat manipulation at Basin A. Rundle and Fredrickson (1981) also have shown that manipulation of impoundments can affect use of habitats by shorebirds, as well as by other avian taxa. However, the varying relationship between shorebird community patterns and water levels indicates that assemblages may be strongly influenced by simple habitats, whether they be wetlands covered with uniform, deep water or sites characterized by dried mudflats. Furthermore, the response of different species to wetland conditions probably varies at these sites, depending on morphological and ecological traits that determine species' habitat use (Colwell and Oring 1988a).

Implications for Prairie Conservation Action Plan

Preservation and management of habitat is of primary importance in prairie conservation strategies. In marine environments, where reclamation continues to etch away at key habitats, the management of critical estuaries has been guided by questions such as, "how much habitat can we afford to lose to development with minimal effects on populations?" (Evans and Dugan 1984). In prairie conservation efforts, we are faced with similar questions but the ecological setting is vastly different from annually and seasonally predictable marine estuaries. To address management issues requires sound data on the ecological relationships between shorebirds and the resources on which they depend during breeding and migration periods.

These patterns underscore the urgency for basic research in areas of prairie shorebird ecology and they emphasize the need to acquire important habitats to safeguard populations. Several key areas need to be pursued. For migrant species, we need a more complete picture of the importance of prairie wetlands as staging areas. In particular, little is known of how individuals make use of food resources that vary with seasonal and annual fluctuations in wetlands and how critical these resources are in the energy budget of migrants. A related issue concerns the faithfulness of individuals to given sites during migration including length of stay and changes in energy stores. Do prairie migrants use traditional staging areas in a manner similar to coastal migrants? Answering such questions will have strong implications for the establishment of reserves within the prairie regions.

For prairie-breeding shorebirds, future research should investigate: (1) basic habitat needs during nesting and brood-rearing stages, (2) variation in reproductive success among different habitats, especially in association with anthropogenic factors (Galbraith 1987), and (3) the relationship between changing wetland conditions, variation in population densities of shorebirds, and predation pressures. Above all else, these questions require firm knowledge of species' population dynamics. To this end, it is important that efforts be expanded to determine population sizes, including patterns of distribution and abundance under the varying environmental conditions that characterize prairie ecosystems.

ACKNOWLEDGMENTS

Research was supported by the Canadian Wildlife Service and National Science Foundation. I thank Clint Jorgenson and Phil Taylor for logistical help at Last Mountain Lake. This manuscript benefitted from discussions with David Delehanty, Cheri Gratto, and Lewis Oring.

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NEW PERSPECTIVES ON CRETACEOUS AND EOCENE EXTINCTIONS

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Mass extinctions at the end of the Cretaceous Period 65 million years ago and near the end of the Eocene Epoch 34 million years ago have long been part of the textbook version of the Earth's geological history. Considered by some authors to be part of a regular, cyclic series of extinctions (Raup and Sepkoski 1984), the Cretaceous and Eocene events are both marked by evidence of extraterrestrial impacts (Alvarez et al. 1980, 1982, Ganapathy 1982).

A simplistic model of extinction has been built around these events. Collision of an extraterrestrial body caused pulverized rock to spread through the Earth's atmosphere, blocking sunlight, and suppressing photosynthetic activity in plants. Mass extinction resulted throughout the food chain (Alvarez et al. 1980).

This model has attracted a great deal of attention and some of its elements have been extrapolated to other situations, for example, predictions of the "nuclear winter" that almost certainly will follow if massive nuclear explosions are set off in some future war. Extensive scientific research into both extinctions has been directed at determining the precise series of events that took place at the end of the Cretaceous and Eocene. Scientists have attempted to make comparisons to estimate what effect on the modern biota a similar event would have.

Here we outline some of the results of our ongoing research into these events and some new insights that are emerging.

THE CRETACEOUS-TERTIARY BOUNDARY

Latest Cretaceous and earliest Tertiary rocks of Saskatchewan are assigned to the Frenchman and Ravenscrag Formations. Until recently, the Ravenscrag was more extensively studied but, in the last few years, we have collected a great deal of data from the Frenchman.

The boundary between the two formations is the Cretaceous- Tertiary (K-T) boundary which marks the end of the dinosaur era and marks changes in many diverse ecological communities. The extinction that occurred is widely discussed today for two reasons. First, the top of the food chain in the Cretaceous terrestrial realm was occupied by animals so strange to us that they excite our imagination and we regard them with amazement. These were the dinosaurs. Second, one of the proposed causes of the extinction involves a series of events starting not on Earth but in space, a large asteroid colliding with the Earth. A less extravagant view holds that the dinosaurs were already on the decline and became extinct gradually.

We have to look at all the evidence to get a complete view of the picture. The Frenchman and Ravenscrag Formations and the boundary coal seam that separates them have been closely examined to find out more about the extinction event. Research has included palynological studies (Nichols et al. 1986), radiometric dating (Baadsgaard et al. 1988), and paleomagnetostratigraphic work (Lerbekmo 1987). The vertebrate record has received only minor attention, mostly in the area of mammals (Fox 1987). There are other vertebrates in the fauna, of course, and it is here that some additional comments can be made.

Currently, 65 species are known from 102 Frenchman localities. Approximately 40 of the species are mammals, representing a study bias. Nonetheless, the number of species illustrates the diversity of the fauna.

The dinosaurs *Edmontosaurus Triceratops, Torosaurus, Thescelosaurus*, an ankylosaur, *Tyrannosaurus, Troodon*, ornithomimids, and *Dromaeosaurus* represent a typical latest Cretaceous (Lancian) fauna. Frogs, salamanders, crocodiles, champsosaurs, turtles, snakes, lizards, birds, and mammals comprise the rest of the record.

By the earlier Tertiary, the dinosaurs were absent. A number of mammalian species (mostly opossums) had disappeared as well but they were quickly replaced by mammals showing similar characteristics to those of their extinct cousins. Thus the mammals were affected very little by the extinctions at the end of the Cretaceous and, in fact, were no longer threatened by the dominant predators, the carnivorous dinosaurs. The mammals rapidly radiated during the early Tertiary. Champsosaurs also grew in size to become even more formidable predators. The rest of the fauna showed relatively little change.

The catastrophic model holds that the extinction occurred rather suddenly, causing mass mortality. If this were so, there should be bone beds of dinosaurs within centimetres of the K-T boundary. Unfortunately, all terrestrial K-T boundary sites are marked by an unconformity: there is a gap in the sediment for which we have no record. It would appear that this would answer the question above: there is no bone bed because the sediment and fossils were eroded away before they could be fossilized. Even in this light we still would expect to find dinosaur bones relatively close, within a metre, to the boundary. But this is not the case. The highest unquestionable occurrence of a fossil vertebrate in the Frenchman Formation is that of a few fragmentary bones of a dinosaur, 10 m below the boundary. We must wonder whether the dinosaur community was around when the asteroid hit.

The examination of this boundary has yielded an immense quantity of data. No matter which view is held as to what caused the extinction 65 million years ago, there is an essential point to be made: any single species can become extinct because of the smallest alteration to its ecosystem.

THE LATE EOCENE

The most profound faunal turnover of the Cenozoic, the time after the dinosaurs, occurred late in the Eocene Epoch about 38 million years ago. On land, more than 30% of the modern families of mammals appeared (Black and Dawson 1966) and many archaic groups disappeared. In the oceans, massive faunal replacements also occurred (Alvarez et al. 1982) but recent study has shown that they were not synchronous.

Recent work by others has cast doubt on the appropriateness of the impact hypothesis to explain this rapid faunal turnover. Prothero (1985) has established that the extraterrestrial impact and a drop in mean temperature of up to 10° C (Wolfe 1978) occurred about 34 million years ago during a time of some minor extinctions but well after the major faunal replacements of the late Eocene. New radiometric dates and magnetostratigraphy (Prothero and Swisher 1989) show that the impact and temperature drop occurred at the Eocene-Oligocene boundary. Contrary to previous claims, the major faunal turnover was not associated with an impact and the impact that occurred did not cause mass extinctions (Prothero 1985, Corliss et al. 1984).

Research on a late Eocene fauna from Lac Pelletier, south of Swift Current, Saskachewan, has provided further evidence. Storer (1988a) reported an extremely transitional mammalian assemblage with about 70 species representing a combination of typically mid-Eocene and typically later genera, many of which had not previously been known to occur together. Not only was this fauna transitional to an unprecedented degree, demonstrating gradual replacement of archaic forms by new ones, but analysis of the rodents showed a major increase in diversity in nearly all groups. The replacement of archaic forms in the late Eocene was evidently spurred by a wave of originations, many of them due to rapid evolution in place.

This rapid evolution of land mammals correlates with profound changes in climate that took place in the late Eocene (Prothero 1985). In North America, this was the time of the breakup of the ancient closed-canopy forests and the gradual emergence of savanna (Webb 1977). Significant climatic change, not extinction, spurred evolution late in the Eocene probably by creating new, more diverse habitat that could be exploited.

Climatic change and increased mountain-building also fragmented North America's fauna. Provinciality, the tendency for climatically different areas to be inhabited by different floras and faunas, was as strong in the later Eocene as at any time in the Tertiary Period (Golz and Lillegraven 1977, Storer 1988a, 1988b) and it appears that separate bursts of faunal evolution in each major province led to the rapid faunal turnover thatculminated in the late Eocene.

CONCLUSIONS

Rapid faunal turnover at the Cretaceous-Tertiary boundary and near the end the Eocene Epoch were formerly considered to be cyclic, extraterrestrially-caused extinctions. Closer examination shows that the two events were extremely different from each other and that both were far more complex than any simplistic model would predict.

Synchroneity of terminal Cretaceous extinctions is in doubt. If there was a true mass extinction, it affected different groups in quite different ways. The only terrestrial groups to suffer extinction, dinosaurs and pterosaurs, have no modern analogs, leaving little room for extrapolation to the present.

The faunal turnover of the late Eocene was not a true extinction but was a rapid faunal replacement. Climatic changes that occurred at that time spurred explosive evolution, not extinction, presumably by creating new and more varied habitat. Collision of an extraterrestrial object with the Earth and a major drop in mean temperature occurred at least 4 million years after the peak of the rapid faunal replacement.

Both events require much more documentation before we can develop predictive models for the present day. Both contain elements that will be extremely valuable in understanding the evolution of the biosphere.

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PLANT CONSERVATION IN THE PRAIRIE PROVINCES: SUMMARY

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One of the first principles of plant conservation is that plants come in two kinds of "packages" or natural units and that both kinds must be accounted for in an adequate conservation program. The first is species populations, collectively termed "flora," and what is most commonly considered in conservation efforts. The second unit is the plant community, collectively termed "vegetation," which consists of species populations in characteristic combinations, amounts, and structures and which is often overlooked in conservation programs. Plant communities are often considered only in the context of being much of the "habitat" of species populations and while conserving particular plant communities as habitat for endangered or otherwise significant species is certainly valid, this approach will not adequately conserve the diversity of plant communities because not all communities contain significant species. Thus, plant communities need to be considered on their own merits as natural units worthy of conservation and, just as ranked lists of species are a basis for conservation action, ranked lists of plant communities should be used similarly.

Several issues in plant conservation are common among Manitoba, Saskatchewan, and Alberta.

(1) While there are broad powers to protect and manage natural resources under a variety of legislative acts, there is no specific legislation dealing with plant conservation. This means that no agency has a specific mandate for plant conservation and none has specific policies in this regard. Lacking a firm basis in legislation and policy, little progress has been made in plant conservation.

(2) Information on the status of plant species and communities is inadequate. There is little information on the status of species populations, their habitat requirements, or population trends or on the types of communities, their amounts, and distribution. The information that does exist is frequently scattered and hard to access or update. No agency systematically gathers information on plant conservation.

(3) Education curricula from elementary school through university lack information on plant conservation. Without an informed public, little support can be generated for political actions that lead to plant conservation through legislation, policy, and program implementation.

(4) More and better coordination and cooperation is needed both among governments and between governments and nongovernmental groups. Our common purpose and restricted resources should lead to cooperation rather than the adversarial relations now too prevalent.

(5) COSEWIC species status reports are a prime vehicle for

species conservation that cuts across provincial boundaries. Greater support for these reports is needed, especially since only three plant species in the prairies currently have COSEWIC status even though plant species are much more numerous than bird or mammal species.

(6) Once species and communities have been identified as high priority for conservation, active monitoring and management is needed. The task is far from complete with the listing of a species or designation of an area for protection.

In the Prairie Conservation Action Plan (PCAP), Goal 5 ("protect ... species designated ... as vulnerable, threatened, endangered or extirpated by implementing recovery and management plans") and Goal 6 ("ensure that no additional species become threatened, endangered or extirpated") focus on the conservation of species populations. Goal 2 ("protect at least one large, representative area in each of the four major prairie ecoregions") and Goal 3 ("establish ... a system of protected native prairie ecosystems") are appropriate to conserving the diversity of plant communities. In planning the actions to accomplish the goals of the PCAP, plant conservation actions, at both the species population and community level, need to be explicitly included. The PCAP is a prime opportunity to draw to the attention of governments and others the current deficiencies in legislation, policy, and programs for plant conservation in the prairie provinces.

PRESENT STATUS AND PRIORITIES FOR PLANT CONSERVATION IN SASKATCHEWAN

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Presently plants in Saskatchewan are protected under the Critical Wildlife Habitat Act, Forest Act, and the Ecological Reserves Act. There is no legislation for saving specific plants except for the Western Red Lily (*Lilium philadelphicum*), Saskatchewan's provincial flower.

A list of the rare vascular plants of Saskatchewan was prepared by Maher, Argus, Harms and Hudson (1979). Dr. Harms is continuing his work on updating species lists for the province and, in doing so, some new species have been added to the rare plant list and others have been deleted. He contends that efforts must be made to consolidate and computerize the available information but there is a lack of financial support for this activity.

A priority list of threatened species should be produced for the Province. Along with this, a publicity campaign should be initiated to create public awareness and generate support. Certain species of extirpated or extremely rare plants may be used as symbols and reasons to save specific vegetation types. This approach could be very similar to that used to protect or reintroduce native fauna.

Other information that is essential for a successful conservation program at the species level includes basic studies on their autecology and synecology. Detailed information on the life history, demographics, and limiting factors are needed to formulate conservation and recovery strategies. Along with this information, there is a need to determine the responses of plants to a variety of management practices that will be needed to sustain plant communities.

Since passage of the Ecological Reserves Act in 1980, only the Assiniboine Slopes area has been designated as an Ecological Reserve. Of the approximately 100 sites identified in the International Biological Program, approximately 75 are potential candidates for designation under the Ecological Reserves Act (Adam 1985). Of those sites identified, approximately 200 square miles (520 km^2) in the Athabasca Sand Dunes in the northwestern corner of the province have been proposed and the Matador Grassland (Mixed Prairie) are under consideration. Preservation and creation of a suburban Fescue Prairie park is currently being considered in Saskatoon.

It is the opinion of the author and colleagues that the goals identified in the Prairie Conservation Action Plan are appropriate and encompassing. Of the prairie vegetation types in Saskatchewan, it seems that preservation of Tallgrass Prairie, Fescue Prairie, and Aspen Parkland should receive high priority. Under present legislation, all prairie types are extremely vulnerable, particularly to agricultural development. Efforts to locate tall grass prairie in Saskatchewan should probably be coordinated with Manitoba because it is most likely that remnants will be found in southeastern Saskatchewan.

Regardless of the approach taken to preserve native plants of the prairie, there must be legislative and financial commitments from government. This support will probably be realized only after significant interest is shown by the general public. Thus, a major thrust of conservation programs must be to educate the public of the impact of man's activities on specific species of plants and the rapid disappearance of ecosystems that are required for their survival.

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PRAIRIE-PARKLAND PLANT CONSERVATION IN MANITOBA

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The perspective for what follows is that prairie and parkland ecosystems are at risk. As a result, endangered species and species preservation are regarded as a segment of the overall problem rather than as a separate problem itself. Clearly then, our focus should be on protection of ecosystems, ecosystem processes, and examples of ecosystems. Species at risk are best considered features to be used to rank sites for attention, when such luxury is available, and to provide heightened sensitivity to controversial sites to assist in their protection. The comments which follow pertain equally to prairie and to parkland ecosystems so that it is not necessary to debate the fascinating question of whether or not aspen parkland is a self-sustaining ecosystem in Manitoba or a successional stage leading to aspen forest.

Manitoba's rare plants have been documented in the National Museum's Syllogeus No. 27, *The Rare Vascular Plants of Manitoba* by David White and Karen Johnson. This publication deals with all of Manitoba and lists some 290 species, many of which are not found in prairie or parkland areas. Indeed, only three Manitoba prairie species, the Small White Lady's Slipper (*Cypripedium candidum*), the Prairie White Fringed Orchid (*Platanthera leucophaea*), and the Great Plains Ladies Tresses (*Spiranthes magnicamporum*), are generally accepted to be threatened in Manitoba. (The first two species are recognized in the Prairie Conservation Action Plan while the third species is under active consideration for review by COSEWIC.).

Many more species are believed to be at risk but there are insufficient data to document their status in Manitoba. One can, of course, take the heroic approach and propose recognition, formal or informal, based on limited data. This has been done and used, in part, to justify establishment of ecological reserves. In one case dealing with the Rose Pogonia (*Pogonia ophioglossoides*), we later found that the scarcity was more apparent than real since publicity of this species lead to the discovery of large populations in several locations. This experience has given rise to a more cautious approach, but in the context that there is never perfect knowledge, some risk to credibility must always be taken and balanced against the risk of species or ecosystem loss. However, steps must be taken to improve knowledge levels of ecosystem composition and plant populations thought to be at risk.

I have fewer concerns regarding species at or near the extremity of the natural range since ranges seem to be much better documented than is scarcity or risk. In these conditions, I believe strong cases can and should be made to protect ecosystems and species "on the fringe" in recognition of the physiological stress and associated genetic activity which occurs along fringes.

Current efforts to obtain appropriate levels of information center on the Rare Plant Alert and the Botanical Survey, both sponsored by the Manitoba Museum of Man and Nature. These programs make extensive use of volunteers. The former involves publishing descriptions of plants thought to be rare and information on their range, habitats, and when to look for each species. These are published in naturalist periodicals with requests for information regarding location and numbers of specimens observed.

The Botanical Survey is a more formalized approach with volunteers receiving training through workshops and undertaking specific projects such as complete surveys of selected areas. This approach can also lead to ecosystem descriptions which, in my opinion, are vital if we are serious about ecosystem preservation. Unfortunately, these descriptive projects are time consuming; species and high quality examples of ecosystems could disappear before documentation is complete. On the other hand, the approach helps sensitize a segment of the public to diminishing ecosystems and gene pools thus strengthening overall support for plant/ecosystem conservation.

When sufficient data have been gathered, descriptive projects can lead to reviews of existing programs which may threaten rare plants. We have discussed our concerns regarding rare plants designated as noxious weeds, with weed specialists. Two important things have already happened. One is serious consideration of removing several rare plants from the Noxious Weeds List; the other is recognition that a plant considered rare in natural habitats is indeed common in many cultivated fields and thus its population is not threatened nor is it necessary to be particularly concerned about loss of genetic material. We expect that this developing relationship can be extended to consideration of herbicide effects on species at risk.

Before going further, other important ecosystem and species protection initiatives in Manitoba should be noted. Examples of prairie and parkland ecosystems are being protected as Wildlife Management Areas, provincial parks, municipal parks, and as Ecologically Significant Areas. Each area makes an important contribution to prairie/parkland ecosystem protection, particularly where ecosystem management and restoration is undertaken as was done in the St. James Prairie in Winnipeg and in Beaudry Provincial Park. I shall, however, deal in detail only with the Ecologically Significant Areas program, the Crown Land Classification Committee, and our new Environment Act since these are perhaps not well known.

The Ecologically Significant Areas program, an expansion of the Ecological Reserves Program, facilitates recognition of private land protection. Ecological Reserves, which can only be established on Crown land, are an effective way to protect ecosystems and endangered species on a site-specific basis provided that large enough areas are designated since the Ecological Reserves Act calls for rigorous protection of reserves and everything found in them. This means that nothing can be removed from or deposited in an ecological reserve except under a permit issued by the Minister. Habitat management activities must also be approved by the Minister. (Advice on these matters is provided by the Ecological Reserves Advisory Committee.)

Private lands recognized as Ecologically Significant Areas must be in their natural state and the landowner must agree to continue to maintain these lands in that state. Landowner participation is voluntary and no incentives are provided other than recognition via a plaque, a certificate of appreciation, and provision of signs to assist in protection. We do, however, keep in touch with participants to encourage continuation of their activity.

So far we have not linked the program to endangered species but we have made particular efforts to include prairie and parkland ecosystems. There is no doubt that identification of one or more endangered species on a property would encourage many landowners to retain the property in its natural state. It would also encourage ecological reserve designation of vacant Crown land and recognition of special ecological values of occupied Crown land (i.e., Crown land in provincial parks, wildlife management areas, etc.) and encourage voluntary protection under other legislation.

The Crown Land Classification Committee has, for some years, been allocating Crown land to use in a multi-disciplinary way. Allocation is done in a committee format with regional experts in the areas of agriculture, wildlife, forestry, municipal affairs, fisheries, water management, and similar disciplines making decisions by consensus. This has resulted in protection of much wildlife habitat and of areas known to be of particular ecological value since the land allocations determine both type of land use and intensity of use. Identification of species at risk and their habitats would facilitate additional protective land allocations.

Manitoba's new Environment Act was proclaimed April 1, 1988. This act requires that developments be licensed before construction/operation starts. The process leading to issuance of a licence includes circulation of the application throughout government and advertising in appropriate newspapers, both provincial and local. Under these circumstances, populations of endangered plants may be protected through conditions on the licence, if issued, or through revision/relocation of the development. Obviously, for the Environment Act to be used it is necessary to know that a particular plant exists on the site proposed for development, that the species is at risk and that the site is critical to species maintenance. Concerns may be raised by the public and by government personnel; hence all data, public and private, can be brought to bear at the discretion of the data managers involved.

Taking another look into the future is useful regarding sustainable development strategies and their potential to contribute to ecosystem and species conservation. The development of concepts is not yet complete but strategies will have to be broad since their origins are the World Conservation Strategy, the Brundtland Commission Report to the United Nations, and the Report of the National Task Force on Environment and Economy. I suggest that the term "sustainable development" should be interpreted to mean that developments will be sustainable rather than that development *per se* is sustainable. Another implication is that developments should be looked at from the "environmentally-friendly" perspective. The tie between ecosystems, endangered species, and sustainable development is maintenance of life support systems and genetic diversity. In the case of genetic diversity, we

STATUS OF PLANT CONSERVATION IN ALBERTA

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INTRODUCTION

The plant session of the Workshop on Endangered Species in the Prairie Provinces, held in Edmonton in January of 1986, focused on the various aspects of plant protection in Alberta. Out of the session came a list of problems with plant protection and recommendations for action (Lee 1987). I thought it would be appropriate here to review those problems and recommendations for action and to look at the progress that has been made since 1986.

The problems were as follows:

(1) Insufficient information available to determine whether or not most rare plant species are in fact threatened, endangered, or extinct. (2) Present lists of rare plant species are tentative as determination of rareness may be biased due to the nature of collections and reporting of information. (3) No central database for maintaining accurate records of plant distribution and abundance. (4) Insufficient recognition of rare plants in planning, assessing, and administering natural resource management programs, and (5) Low public awareness.

The recommendations were as follows:

(1) Refine the definition of rare plant species to include widespread species that are rare throughout their range, species that occur as disjunct populations throughout their range, and species that are localized endemics. (2) Define priorities for rare plants by ranking species in existing rare lists, identify areas where concentrations of rare species occur, and areas with restricted habitat types that support rare species. (3) Identify geographic areas where data gaps exist and target them for study and collection. (4) Expand general public awareness. (5) Publish lists of rare/threatened plants. (6) Involve naturalists and naturalist organizations as well as institutions in the collection of information on locations and site characteristics. (7) Establish a data handling system for rare plants. (8) Designate and properly support a lead agency/group for rare plants. (9) Pursue a government (i.e., legislative) and non-government approach such as private landowner contracts for protecting rare plants. (10) Support research into the population biology of rare plants. (11) Ensure that rare plants are considered in all planning, environmental assessment, and natural resource management activities. (12) Develop objectives and implement management practices to ensure that plant species do not become rare, threatened, or endangered.

ALBERTA FORESTRY LANDS AND WILDLIFE PROJECTS

In response to these recommendations and in co-operation with a number of other groups and agencies such as World Wildlife Fund's Wild West Project and local municipalities, Alberta Forestry Lands and Wildlife has initiated a number of projects. One of the first was, through a detailed literature review, to look at the status throughout their range of each of the species on the most current list of rare plants for Alberta. One quarter of Alberta's plants, 360 species, are on the rare list (Packer and Bradley 1984). The purpose of the literature review was to develop priorities for further species studies and to begin to draw together the necessary background information on each species to refine the rare species lists (Fairbarns et al. 1986, Wallis 1986, Wallis et al. 1986a, Wallis et al. 1986b).

Having developed an initial list of priority species, the next step was to locate the natural populations of these species and attempt to determine their status in Alberta. The areas known to have a concentration of species on the rare plant lists include the Cordillera, the Canadian Shield, the southern grasslands, and a diverse area in the southwest corner of the province where several natural regions converge.

A study area in this diverse southwest corner was chosen which included previously-recorded locations for 28 priority rare species. Of the species reviewed, this study found four to be endangered in Alberta (*Allium geyeri* S. Wats, *Castilleja cusickii* Mutis ex L.f., *Cypripedium montanum* Dougl. ex Lindl., and *Iris* *missouriensis* Nutt.), one to be threatened (*Astragalus lotiflorus* Hook.), 15 species to be rare but not threatened and three species were recommended for removal from the rare listing (Wallis et al. 1986c).

In 1987, a second similar broad study was initiated to locate rare plant populations, concentrating on sand dunes of the prairies and parklands - habitat for thirty species of rare plants. Two species were considered endangered, *Cyperus schweinitzii* Torr. and *Tradescantia occidentalis* (Britt.) Smyth.. Three species were considered threatened, *Abronia micrantha* Torr., *Chenopodium subglaburm* (S. Wats.) A. Nels., and *Lygodesmia rostrata* A. Gray. Most species were considered rare and five were recommended for removal from the rare species list (Wallis and Wershler 1988).

This study also compared the present extent of active dunes to the historical extent and concluded that extensive stabilization has occurred. As many of the rare plant species found in sand dune habitats depend on active and partially stabilized dunes, it was concluded that dune stabilization constitutes a major threat to those species.

These broad studies have proven to be extremely important in helping to sift through the large number of "rare" species in order to focus in on those species and habitats in the most need of protection. Under the Wilderness Areas, Ecological Reserves and Natural Areas Act, there is provision to protect habitats of rare plant species. Ecological reserves are established to protect, among other things, "rare and endangered plants or animals that should be preserved" (Wilderness Areas, Ecological Reserves and Natural Areas Act 1980). Under the same act, natural areas can be established to "protect sensitive...public land from disturbance" and have also been used to protect known rare plant populations. Several areas which may qualify for protection under this act have been identified through these studies.

Additional work has been initiated on those species thought to be endangered. *Cypripedium montanum* Dougl. ex Lindl. is known from only a few locations in Alberta, occurs only in small numbers, and has a low reproductive rate. As most of the Alberta populations occur on public land, a report including management recommendations was developed. This report was distributed to land managers and appropriate government personnel (Wilkinson 1987).

Iris missouriensis Nutt. is a species found in small populations and restricted in Canada to southwestern Alberta. It is considered endangered because populations occur in seepage areas and are threatened by drought, cultivation, heavy grazing (although moderate grazing appears beneficial), and invasion of introduced species. One population is within a provincial park but most are found on private lands. For this species, landowners were contacted, a population census was completed and a monitoring program was initiated (Wallis 1988).

To increase the level of public awareness of the need for rare plant protection, a series of public information sheets is being developed on Alberta's rare plants. Two information sheets have been printed. Eventually one on each of the endangered and threatened species will be available.

CONSERVATION GROUPS

The Alberta Native Plant Council (ANPC), a conservation group incorporated in 1988, has taken over the task of obtaining landowner agreements for the protection of significant populations of *Iris missouriensis*. For this and three other species (*Abronia micrantha*, *Chenopodium subglabrum*, and *Tradescantia occidentalis*), the preparation of status reports has been initiated. These will be presented to COSEWIC (Committee on the Status of Endangered Wildlife in Canada) with recommendations for each species for designation as threatened or endangered at the national level. In addition, ANPC has initiated several projects such as workshops, a newsletter, field trips, courses, and cooperative projects such as a plant study group and a May species count aimed at increasing public awareness.

In one of the first such projects of its kind in Canada, the Red Deer River Naturalists (RDRN) negotiated a conservation lease on a springs area near Red Deer. The site provides habitat for at least two species on the Alberta rare plant list (*Malaxis paludosa* and *Drosera linearis*) as well as several native orchid species. The RDRN have fenced out the site and intend to initiate a monitoring program.

DEVONIAN BOTANIC GARDENS

The Devonian Botanic Gardens is involved in the Canadian Plant Conservation Programme and is presently editor of the programme newsletter. This Programme is developing guidelines for ex situ conserva-

THE BULL TROUT: VANISHING FROM THE PRAIRIE AND PARKLAND OF WESTERN ALBERTA

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East of the continental divide in Canada, the Bull Trout (*Salvelinus confluentus*) was formerly abundant in all of the major drainages from the St. Mary River northward to the Peace River in Alberta. Population levels were formerly high and large subadults and adults once occurred in the plains portions of these rivers downstream to at least Lethbridge on the Oldman River, the vicinity of Carseland on the Bow River, the badlands of the Red Deer River near Morrin, and the Edmonton area of the North Saskatchewan River. Photographs in the provincial archives in Edmonton document impressive catches by anglers near Edmonton near the turn of the century and Whitehouse (1946) describes fishing for them at the mouth of the Waskasoo Creek in the city of Red Deer.

The Bull Trout has declined in numbers in Alberta and is rare or absent throughout much of its former range, especially in the downstream reaches of rivers in which it occurred (Roberts 1987). Over-exploitation of this species by anglers is probably the most significant factor in its decline (Anon 1985, Roberts 1987). The St. Mary River still has a small Bull Trout population upstream of the St. Mary Reservoir. However, below the reservoir and in adjacent reaches of the Oldman River, Bull Trout are no longer found. The Oldman River presently contains small Bull Trout populations in the reaches and tributaries upstream from the Lethbridge Northern Irrigation Weir. These populations could increase in numbers with appropriate management. However, the proposed impoundment of the Oldman River would block upstream and downstream migration of Bull Trout such that they would be denied access to formerly occupied habitat in the prairie portion of the river.

The Red Deer River has small numbers of Bull Trout in the upper reaches but access to formerly occupied downstream waters is blocked by the Dickson Dam. Impoundment of east slope streams has and will continue to act as a barrier to access to the prairie portions of these streams by Bull Trout. Arrangements are being made by the author to prepare a COSEWIC status report for this species in Canada, however, there is already sufficient evidence without a more comprehensive report that prairie populations of the Bull Trout are clearly endangered.

Present regulations penalize fish for growing large enough to spawn by permitting the harvest of fish 40 cm or larger. Permitting any harvest at all suggests to the angling public that there is indeed a harvestable surplus, which is certainly not the case in most Bull Trout populations in the Saskatchewan drainage system in Alberta.

Angling should be permitted on a catch and release basis only to ensure that more Bull Trout live to reproduce and to permit repeat spawning by older, larger fish. Mitigation plans dealing with water management on rivers where this species occurs or has occurred should provide for fish passage and/or spawning facilities to ensure the future of this species in traditional habitat.

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CONSERVATION OF HERPETOFAUNA IN THE PRAIRIE PROVINCES

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INTRODUCTION

There are 18 species of herptiles known to occur in Alberta (Butler and Roberts 1987), 19 in Saskatchewan (Secoy 1987), and 22 in Manitoba (Preston 1987). Only one of these species, the Northern Prairie Skink (*Eumeces septentrionalis septentrionalis*), was assigned a vulnerable status by COSEWIC in 1989. However, the lack of official designation by COSEWIC is primarily due to the paucity of information on many herptiles rather than their true status.

Ten species of reptiles and amphibians were recognized as species of concern by the Prairie Conservation Action Plan (World Wildlife Fund Canada 1988). The list of species includes: Plains Spadefoot Toad (*Scaphiopus bombifrons*), Great Plains Toad (*Bufo cognatus*), Northern Leopard Frog (*Rana pipiens*), Western Painted Turtle (*Chrysemys picta*), Short-horned Lizard (*Phrynosoma douglasi*), Northern Prairie Skink, Western Hognose Snake (*Heterodon nasicus*), Bullsnake (*Pituophis melanoleucus*), Eastern Yellow-bellied Racer (*Coluber constrictus flaviventris*), and Prairie Rattlesnake (*Crotalus viridis viridis*). Such a listing represents nearly half of the herptile species found in the prairies. Thus, as a group, herptiles are the most endangered group of organisms in prairie Canada.

CONSERVATION ISSUES

Disappearance of the Northern Leopard Frog

In the 1970s, there occurred a massive, North America-wide population decline of Northern Leopard Frogs (Gibbs et al. 1971, Roberts 1987). The decline was so sudden and so complete that study was impossible. A disease known as "redleg," overwintering mortalities, and toxic substances have all been implicated in the decline but the overall cause is unknown.

Exploitation of the species for laboratory use may have impacted the species as well. For example, up to one million pounds (455,000 kg) of Northern Leopard Frogs have been collected in Manitoba in a single season (Koonz, pers. comm.). When you consider that there are eight to 12 frogs to the pound, it is not hard to imagine a population impact of this kind. In fall 1988, 20,000 pounds (9000 kg) of Northern Leopard Frogs were collected in Manitoba (Koonz, pers. comm.).

In Alberta, Wayne Roberts of the University of Alberta is considering a pilot reintroduction program for the leopard frog. However, the species has plummeted to such low numbers in the province that it is not known whether Wayne will be able to find a suitable donor population (see paper this session).

Public Persecution

Herptiles, especially snakes, have not had a good reputation with the general public in the past. This has lead to the persecution of many species, most notably the Prairie Rattlesnake and the Bullsnake. These species are especially vulnerable in the spring and fall as they congregate near hibernacula. Snake collecting for scientific use and the pet trade is also a conservation concern. As many as 100,000 Red-sided Garter Snakes (*Thamnophis radix haydeni*) have been collected in a single season in Manitoba (Koonz, pers. comm.).

Habitat Loss

The loss of critical habitat is threatening much of the prairie herpetofauna. This is especially true of species with unique habitat requirements such as the Western Hognose Snake (sandhills/plains) and the Plains Spadefoot Toad and Great Plains Toad which require the same sandy areas along with wetlands for breeding. Without conserving the habitat we shall simply not be able to conserve these species. To save endangered species you need to save endangered spaces.

AN ACTION PLAN FOR THE RECOVERY OF THE NORTHERN LEOPARD FROG IN ALBERTA

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INTRODUCTION

The Northern Leopard Frog (*Rana pipiens*) is presently absent from much of its former range in Alberta. Mass extirpation occurred abruptly during 1978/1979 throughout central and southern Alberta (Roberts 1981). Where populations did not disappear completely, the number of individuals present was greatly reduced. Since 1979, some of the smaller more fragile populations in southern Alberta have disappeared (personal observations). The small number of extant populations in southern Alberta are isolated and separated from formerly occupied areas by geographic and climatic "barriers." Vast areas lacking suitable spawning or overwintering sites, or both, prevent range expansion of the reduced extant populations should such populations increase in numbers. As a consequence, natural recolonization of suitable habitat formerly occupied by the Northern Leopard Frog is unlikely to occur.

Roberts (1986) reviewed the recent history (1979-1986) of the Northern Leopard Frog and recognized the need to reintroduce this species within its former range. Cottonwood Consultants (1986) recommended that this species be regarded as "threatened" within Alberta and reiterated the need for reintroduction. For extant populations and those to be reintroduced, it was recommended that "legal protection should be accompanied by an education program pointing out the decline in numbers and requesting assistance in maintaining habitat and minimizing disturbance."

While the present status for this species is that of a "non-licence species" under the Wildlife Act in Alberta, its special needs are partially met by regulation of commercial collecting and trafficking. Restrictions on exploitation of this species are important for minimizing depredation by humans as a cause of decline or extirpation of populations or as an impediment to population growth of healthy populations. The use of Northern Leopard Frogs as fish bait by anglers is to be discouraged as this practice may, at the local level, provide a serious source of mortality for frogs.

The Northern Leopard Frog has been identified as a "species of concern" by the Prairie Conservation Action Plan (World Wildlife Fund Canada 1988) with a status report and management plan identified as appropriate "action required." It is clear however, from the observations of Roberts (1986) and Cottonwood Consultants (1986), that a recovery plan is also required within those areas of central Alberta where extirpation has occurred.

PROPOSED ACTION

1. Feasibility Study

The location of potential sites for reintroduction of this species, as well as potential donor populations (sources of adult frogs for reintroduction), was undertaken during 1987 and 1988. Final choice of a donor population will depend on abundance of breeding adults during spring 1989.

2. Reintroduction

A pilot project for the reintroduction of Northern Leopard Frogs to a study site formerly occupied by this species will be undertaken during April-May 1989. The site is characterized by the presence of stable spawning habitat consisting of permanent natural ponds and a man-made lake/marsh system maintained by Ducks Unlimited. Overwintering habitat is provided by the impounded creek and water from a spring tributary to the lake. Rock piles consisting of fist-sized rocks within the permanently filled creek bed will afford some protection from predacious Northern Pike (*Esox lucius*) during the winter.

The surrounding uplands are not cultivated and are free from other human disturbance. There is easy access for regular monitoring. A maximum of 10 pairs of adult Northern Leopard Frogs will be removed from spawning congresses in the Killarney Lake area of east-central Alberta or the northeast side of Elkwater Lake and transported to the site where they will be released prior to spawning.

3. Monitoring

The development and transformation of tadpoles will be documented and an assessment of numbers of young of the year present prior to overwintering determined. In the event of sickness or death of individuals, an attempt will be made to determine the cause. Numbers of individuals present in the following spring will be determined in order to assess overwintering survival. Overwinter survival and subsequent spawning of introduced adults will be monitored. Monitoring will continue annually if the reintroduction is successful.

4. Future Reintroductions

If this pilot project is successful, other reintroductions should be made into widely separated sites throughout the formerly occupied range to act as core populations from which adjacent suitable habitat may be colonized.

5. Education

It is important that public education accompany reintroductions to ensure that people do not thoughtlessly kill or collect this species while populations are small and fragile.

6. Legal Protection

The Northern Leopard Frog should be legally protected by prohibiting its killing or collection as present low numbers of this species do not provide any harvestable surplus. It should be recognized as a threatened species within Alberta.

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WORKING SESSION ON THE MANAGEMENT AND RESTORATION OF CANADIAN TRUMPETER SWANS

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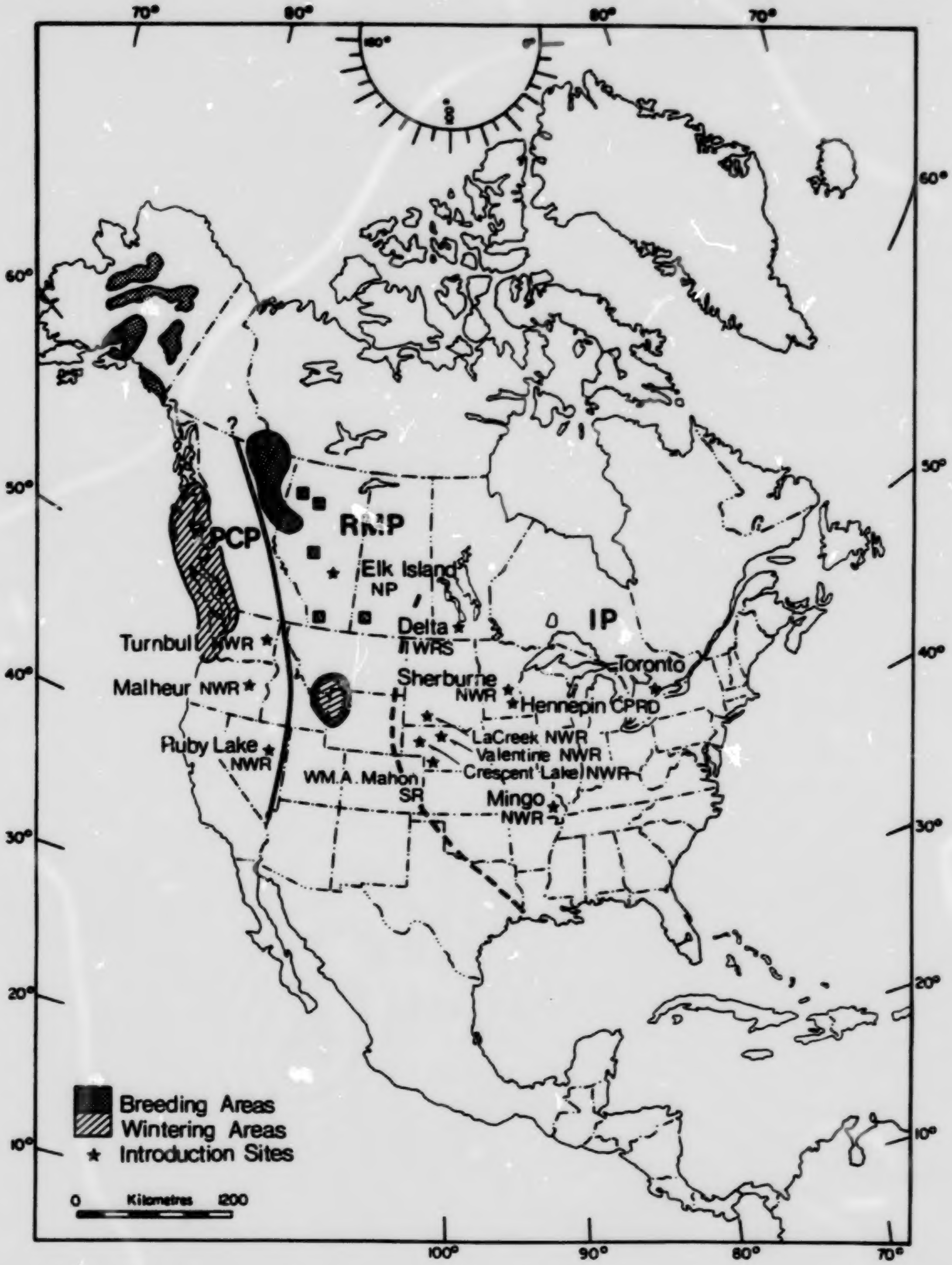
The following is a summary of presentations made during the workshop session on Trumpeter Swans (*Cygnus buccinator*). Presentations focused on the history, status, and management of the Interior Canadian subpopulation (Len Shandruk), the Saskatchewan population (Marlon Killaby), and the Elk Island National Park transplant project (Terry Winkler). The core information was provided by each participant, with some editorial additions by the chairman to include points of background and discussion.

At present, North American Trumpeter Swans are divided into three relatively distinct populations: Pacific, Rocky Mountain, and Interior. The Pacific population contains approximately 12,000 birds which breed in southern and central Alaska and winter primarily in coastal areas of British Columbia, Washington, and Oregon. This is the largest population, and is the source flock for transplant populations which have been established in Oregon, Washington, and Nevada.

The Interior population has been created by transplanting surplus Trumpeter Swans from the Red Rocks Lake National Wildlife Refuge in the Tri-State area of Wyoming, Montana, and Idaho. The largest flocks in this population are located at the LaCreek National Wildlife Refuge in South Dakota (250 birds) and the Hennepin County Park Reserve in Minnesota (200 birds). (Figure 1).

The Rocky Mountain population numbers approximately 1,600 individuals in two groups. Approximately 400 individuals are resident and non-migratory in the Tri-State area. The majority of the Rocky Mountain population (approximately 1,200) migrates from breeding areas in western Canada to wintering grounds in the northern Rocky Mountain area of the United States. This Canadian subpopulation is the focus of the following workshop discussions.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Malheur NWR
Ruby Lake NWR
WM.A. Mahon SR
Sherburne NWR
Hennepin CPRD
Toronto
LaCreek NWR
Valentine NWR
Crescent Lake NWR
Mingo NWR
■ Breeding Areas
▨ Wintering Areas
★ Introduction Sites
0 Kilometres 1200

Figure 1. Distribution of Trumpeter Swan populations in North America.

THE INTERIOR CANADIAN SUBPOPULATION OF TRUMPETER SWANS

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I. INTRODUCTION

This presentation provided a broad overview of the historic and current status of the Interior Canada subpopulation of Trumpeter Swans (those Trumpeter Swans that breed in Canada). A description of both breeding and wintering habitats, along with population limiting factors was reviewed. Current and future management needs for this subpopulation was also presented.

II. HISTORIC RANGE, MANAGEMENT AND POPULATION

The historic range of the Trumpeter Swan (*Cygnus buccinator*) covered much of pristine North America, with summering areas throughout much of north-central North America and wintering sites along the Mississippi valley and the estuaries of the Pacific, Atlantic, and Gulf coasts (Shandruk 1987). In Canada, the Trumpeter Swan nested from Ontario to British Columbia, north as far as southern portions of the Northwest Territories and the Yukon. The Great Plains and prairie potholes were not considered to be important breeding habitats for the continental population. By 1832, the Trumpeter Swan was no longer breeding in the eastern half of the North American continent (Gale et al. 1987). During the early 1880s, trumpeters that nested in Western Canada and USA were nearly exterminated by the commercial trade in swan skins, subsistence hunting, recreational hunting, and the destruction of habitat.

By the early 1890s the known population of Trumpeter Swans in the west had dwindled to 50 non-migratory birds in the Yellowstone-Tri-State area of Wyoming, Montana, and Idaho. About 77 migratory trumpeters were presumed to be breeding near Grande Prairie, Alberta and wintering in the Tri-State area (MacKay 1978). Believing that the extinction of the species was likely, the Canadian and USA governments began to take steps to protect and enhance the trumpeter's survival.

Major early management steps which were important to the recovery of the Canadian subpopulation included:

1918The Grande Prairie breeding flock discovered approximately 100 birds.

1919Core wintering areas protected by the creation of Yellowstone National Park.

1920Migratory Bird Sanctuaries created by the Canadian Government in Alberta and British Columbia which protect selected breeding and staging areas.

1931Cypress Hills Provincial Park established. This allowed protection of swans that established here in 1950.

1935Red Rocks Lake National Wildlife Refuge established in the Tri-State area to protect breeding habitat for the non-migratory population.

1946Canadian Wildlife Service and Alberta Fish and Wildlife initiated population surveys in the Grande Prairie area.

1978Trumpeter Swans designated as "Rare" by the Committee on the Status of Endangered Wildlife in Canada.

1983North American Trumpeter Swan Management plan established population objectives, management concerns, and action plans for Trumpeter Swans across North America.

Based on winter censuses, the Interior Canada subpopulation now numbers about 1,200 birds, while the Tri-state subpopulation numbers 400, for a total Rocky Mountain population of 1,600 trumpeters. Major breeding flocks in Canada and their sizes are: Grande Prairie (400); Fort St. John (100); Toobally Lakes, Yukon (125); and S. Mackenzie, Northwest Territories (150). Other smaller flocks are found scattered from the Cypress Hills to southwestern

Northwest Territories and number no more than an additional 100 birds in total. Known breeding areas, therefore, account for only 1,275 of the estimated 1,600 trumpeters in the Rocky Mountain population. The remainder may be migrants from Pacific population breeding grounds or residents of a presently unknown breeding area.

III. HABITAT USE

A) Summer

Trumpeter Swans migrate to their Canadian summering grounds 2 to 3 weeks before most breeding lakes become ice-free. In the Peace River district this occurs during the month of April and is progressively later in more northern areas. Swans arriving prior to breakup utilize small sloughs and backwaters of rivers that open earlier than lakes. Swans have been observed feeding in stubble fields of barley, especially when breakup on lakes was delayed.

In the Peace River district, swan breeding and staging lakes are located in the aspen parkland and the boreal mixed-wood forests. Breeding lakes tend to be large (mean, 140 ha; range 54-394 ha) but size does not appear to be a critical determinant for selection by swans. Holton (1982) found that the mean width and total edge length were significantly greater in nesting lakes than those not used for nesting. Because swans select nest sites mainly in emergent vegetation, predominantly bulrush, cattail, and sedges, it has been concluded that breeding swans selected lakes on the basis of the availability of nest sites. Though the abundance of submerged macrophytes does not seem to differ from occupied to unoccupied lakes, it has been observed that adults with cygnets used portions of lakes where the biomass of submerged aquatics was high. Breeding lakes are almost universally occupied by only one breeding pair.

Today, the Peace parkland is almost totally in agricultural production and there has been extensive industrial activity associated with the petroleum and forest products industries in both the parkland and mixed wood forest biomes. The Alberta land use restrictions on important swan wetlands have helped to reduce potential land development impacts on lakes bordering crown lands. The lack of land-use controls on private lands adjacent to important swan lakes has, however, allowed incompatible land uses such as rural subdivisions to decrease the breeding habitat quality of these wetlands. Recreational use of breeding lakes in both biomes has had, and will continue to have, an impact on Trumpeter Swan habitat quality. Land-use restrictions and habitat protection for swan breeding wetlands is required on a Canadian range-wide basis.

The second largest breeding concentration of Trumpeter Swans in Canada occurs in northeastern British Columbia, southern Yukon and the Northwest Territories border area. This northern extension of the Grande Prairie flock is located primarily on foothills and mountainous boreal mixed-wood forest which are interspersed with wetland complexes. In this area Trumpeter Swans utilize habitats that can be classified into four types:

1.Long, narrow, deep lakes that are used for summering and staging;

2.Perched basins and associated terraces;

3.Outflow streams in valley bottoms with connections to beaver impoundments or perched basins; and

4.Oxbow wetlands associated with major river channels such as the Liard and Nahanni rivers.

The latter three types of wetlands provide the major nesting habitat for swans in these flocks.

Human impact on swan habitat in these northern breeding areas has generally been minimal. However, this may change. Exploration for oil, gas, and minerals continues throughout the region; float trips on river systems in the National Parks and fly-in fishing lodges are becoming very popular; and hydroelectric development on the Liard River is possible. With the exception of National Parks, there are no specific measures in place to protect key habitats in this area. Most of the Trumpeter Swan habitat, however, is on crown lands. All developments within the region require land-use permits and are therefore subjected to an environmental screening process.

B) Winter Habitat

Trumpeter Swans leave their Canadian breeding areas as their fall staging habitats freeze during late October to mid-November. Collaring information has indicated that the Northwest Territories' trumpeters initially stage in the Peace River District. They then move with the Grande Prairie flock and stage in southwestern Alberta near Waterton National Park.

From southern Alberta, migration along the eastern flank of the Rocky Mountains is rapid and direct to the Tri-State Region. Canadian breeders join the sedentary Tri-State breeding subpopulation by mid-November in the Yellowstone Lake area and remain there well into December, or until wetlands freeze over and limit their food supply. The majority of Canadian breeders then move west to the key wintering area on a 25 km stretch of open water along Henry's Fork of the Snake River centered at Harriman State Park in Idaho. Other collared Canadian breeders including some from the Northwest Territories have been located in the Teton basin, Hebgen Lake, Grand Teton National Park, and Red Rock Lakes National Wildlife Refuge.

Trumpeter Swan wintering habitat in the Tri-State is characterized by shallow lakes, streams, rivers, and ponds with adequate aquatic submergents for feeding. Warm water springs and/or turbulent fast flowing waters are responsible for keeping areas from icing over during periods of low temperatures.

Because the majority of Canadian swans traditionally utilize a very restricted area of the Snake River, they are very vulnerable to catastrophic losses during very cold winters. Irreversible declines in the population could result from disease, disturbance, habitat destruction, or change in habitat availability associated with extremely cold weather and/or reduced winter flows from Island Park Dam which controls water levels in the Henry's Fork of the Snake River. Management and preservation of severely limited natural wintering habitat and measures to encourage pioneering of new wintering areas are the most critical factors for the maintenance and/or expansion of the Interior Canada subpopulation.

IV. POPULATION - HABITAT RELATIONSHIPS

A) Grande Prairie Flock

From 1959 to 1977 the Grande Prairie flock remained remarkably stable. This was apparently due to the limited availability of winter habitat. It has been found that the annual loss of swans from the Grande Prairie flock shows a significant correlation with winter severity in the Tri-State area. Because this flock did not use the supplemental feeding areas available at Red Rock Lakes National Wildlife Refuge, they were vulnerable to severe cold weather which reduced the availability of ice-free feeding on the Snake River, and increased energy demands.

From 1980 to 1985, however, the Grande Prairie flock grew at approximately 10% per year. This recent growth, and the increases of the other Canadian flocks, followed the increase in winter swan use of the Snake River at Harriman State Park. This was made possible by the restoration of higher water flows in 1968. Prior to this time, water releases from Island Park Dam were completely curtailed in January and February, after swans had settled in for the winter and during the coldest months when little habitat was available elsewhere. Higher flow rates have increased the availability and stability of the Harriman Park winter food resource and probably reduced the mortality rate of the Grande Prairie swans, allowing this flock to grow and begin dispersal by the mid-1970s. From this primary wintering area at Harriman, the increasing number of swans began to expand their winter range to include Hebgen Lake, the Teton River and habitat within Grand Teton National Park.

B) Northwest Territories Flock

Trumpeter Swans were first observed in the Northwest Territories in 1970, but breeding was not recorded until 1977. The Canadian Wildlife Service began detailed helicopter census of this flock in 1985. Our surveys indicate that this flock is growing at a significant rate. In 1988, this growth rate was reduced drastically due to difficult conditions on the wintering area and torrential rain storms during the cygnet hatch. It is anticipated that in the long term this flock will continue to increase, but not at the rates observed for the Grande Prairie flock since this flock is probably near the limit of it's northern range.

V. CURRENT MANAGEMENT

In an effort to ensure continued growth and expansion of the Interior Canada subpopulation, the Canadian Wildlife Service is currently involved in the following management activities:

A) Revision Of Current Management Plans

The Pacific Flyway Trumpeter Swan Technical Subcommittee is currently in the process of revising the Rocky Mountain Population portion of the North

American Management Plan for Trumpeter Swans. A major thrust of this revision is to expand winter and spring distribution of both Interior Canada and Tri-State subpopulations. As a first step in attaining this goal, a relocation effort was initiated at Red Rock Lakes. A scaring program was also initiated on the Snake River in mid-November to encourage Trumpeter Swans to pioneer new wintering areas farther south. In addition, a major effort will be made to identify and document the key staging, moulting, and breeding habitats in Canada. This should aid in determining the origin of the "extra" birds in the Canadian subpopulation. Both Alberta and Saskatchewan have also set population goals for Trumpeter Swans within Provincial Species Management Plans (Brechtel 1982).

B) Collaring and Banding in the Northwest Territories

Since 1985 the Canadian Wildlife Service has been surveying, collaring, and banding Northwest Territories' trumpeters in order to determine the migration and wintering areas of this flock. In addition, we are collecting information on flock productivity, breeding habitat use, and flock limiting factors.

C) Elk Island Transplant

This pilot project will develop and test techniques which will allow for the re-establishment of small breeding flocks within the historic range. Ultimately we would also like to establish new wintering traditions with these pioneer breeding flocks.

D) Flock Monitoring

In cooperation with the Alberta Fish and Wildlife Division, the Canadian Wildlife Service continues to conduct fall production surveys on the Grande Prairie flock. These provide an indication of the annual productivity of the flock and an indication of the long term trend and health of swans breeding in Canada. This survey also helps to evaluate the impact of cygnet removals required for transplant efforts. In 1990, the Canadian Wildlife Service will again coordinate the 5-year North American range-wide survey in Canada. This survey will provide an update to the 1985 Trumpeter Swan range-wide survey, and will allow an evaluation of the status of the Interior Canada subpopulation.

E) Enforcement of Land-Use Guidelines

Alberta is providing the lead in the development and enforcement of restrictions to land use on crown lands surrounding swan lakes. The main purpose of these restrictions is to provide a 500 m. non-active buffer zone around lakes during the breeding season, and to protect lakes from habitat destruction and degradation. There is little control of land use on private lands adjacent to wetlands that are important to Trumpeter Swans. Clearly, there is a need to develop and implement appropriate land-use restrictions to protect these areas.

F) Public Information And Education

In cooperation with Parks Canada, the Canadian Wildlife Service has developed a public education package to inform the public about the Elk Island National Park transplant project and solicit their assistance in locating and reporting collared swans. We have also completed a public display on the Northwest Territories flock, and are working with the several municipal and private groups to develop small public interpretation programs. There is a need to inform the general public, private landowners, and government land use agencies on the need to preserve and protect swans and their habitat.

G) Other Minor Management Activities

1)Blood sampling to establish baseline blood characteristics for rehabilitation work and disease control;

2)Moult physiology study to determine the growth characteristics of flight feathers, allowing us to better predict when various age classes and sexes can be expected to be flightless;

3)Evaluation of patagial wing markers. Due to public concern regarding the icing of neck markers we are currently evaluating patagial wing markers as an alternative to neck markers. We have marked about 25 cygnets with these markers.

4)City of Camrose captive breeding program (operated with the Camrose Veterinary Clinic) provides a place for rehabilitation of injured birds and location for birds that cannot be released to the wild; and public display.

CONCLUSION

The first priority in management of the Interior Canada subpopulation should be to provide protection and maintenance of breeding and staging habitats in Canada. Efforts to diversify the breeding and wintering habitats are also necessary to provide long term security for this species. To facilitate these efforts it will be necessary to continue to mark and monitor Canadian breeders. This will allow a reasoned evaluation of how well management programs are meeting established goals.

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THE ELK ISLAND NATIONAL PARK TRUMPETER SWAN REINTRODUCTION PROJECT

Terry Winkler

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[Note: The following is a summary of Mr. Winkler's verbal presentation, combined with information from Shandruk and Winkler (1989) and a media package prepared for Elk Island National Park by M. Christman, Park Interpreter.]

I. PROJECT SUMMARY

The Beginning

In 1982, a management plan for Trumpeter Swans (*Cygnus buccinator*), prepared by the Alberta Fish and Wildlife Division, identified inadequate winter habitat in the Tri-State area as the main factor limiting growth of the Grande Prairie Trumpeter Swan population (Brechtel, 1982). Human disturbance and habitat loss/deterioration in the Grande Prairie area itself are also affecting Trumpeter Swans there.

A transplant program was recommended, which would involve relocating some birds from the main nesting area near Grande Prairie, to other suitable habitats in the province. One of the areas selected was Elk Island National Park.

Why A Transplant?

The purposes of the transplant program are:

1)To diversify summering and breeding range of Trumpeter Swans in Canada to include areas of their former breeding range.

2)To diversify migration and wintering traditions to places other than the Tri-State area, where crowding and habitat over-utilization by the swans leaves most of the Interior Canada Trumpeter Swan population vulnerable to diseases, parasites, habitat destruction, or natural catastrophes (floods, droughts, freezing over of winter feeding sites). Lead poisoning is also a problem there. (The Tri-State area is at the confluence of Idaho, Wyoming, and Montana. Major overwintering concentrations occur in Yellowstone and Grand Teton National Parks, and on the Teton and Snake rivers.) Moving some breeding pairs away from Grande Prairie may encourage them to migrate to a new area. If the Elk Island project is successful, the program will likely be expanded to other sites in Canada and the USA.

Why Elk Island?

Besides habitat suitability, Elk Island also offers isolation and protection for the birds, accessibility for researchers and those monitoring the birds progress, and (eventually) public on-site viewing and educational opportunities.

Goals of the Elk Island Transplant

1)To introduce 12 family groups of Trumpeter Swans over 3 years (1987-89) from the Grande Prairie flock, to suitable wetlands inside the park.

2)To refine capture and transplant techniques, marking and tracking devices, and procedures.

3)To determine if cygnets released at Elk Island will consistently home to the park.

4)To assess the impact of the relocation on both cygnets and adult guide birds.

5)To assess the impact of the transplant on the Grande Prairie Trumpeter Swan population.

6)To establish a free-flying, breeding flock of 10 pairs of Trumpeter Swans in Elk Island.

7)To evaluate the impact the swans will have on existing waterfowl and other resources in the park, should they become seasonal residents.

Previous Releases at Elk Island

Two pilot releases in Elk Island in 1983 and 1984 involved 20 and 13 birds respectively. Although none of the birds are known to have returned to the park, much information, valuable in the present project design, was obtained. In 1987, a second series of releases was begun.

These releases differ from the previous releases in several ways:

1)Complete family groups of swans from Grande Prairie are being used. In 1983 and 1984 adult guide birds from Powell River, British Columbia and young hatched from Grande Prairie eggs at the Brooks Wildlife Centre were bonded into family groups and released at Elk Island. The adults were to have led the cygnets across the Rockies to the unlimited coastal wintering habitat of the Pacific flock. Such a venture has worked with Canada Geese, but did not materialize in this case.

2)Timing. In 1983-84, releases of the captive birds were carried out in late August and early September. In 1987-88, to facilitate capture and ensure the birds would remain in Elk Island for a longer period of time before migratory urges took effect, releases were conducted in mid-July. Moulting adults are flightless in July, as are the young, which have yet to develop flight capability. In 1989 a fall capture and release is likely to reduce mortality among the cygnets, which will be older, stronger, capable of feeding on their own, and more able to cope with the stress of relocation.

3)Transport of Swans. Where possible, the birds are flown between airports, near the capture and release sites, reducing travel time and stress on the birds.

4)Release procedure. Because the releases in 1987 and 1988 occurred earlier in the nesting season than in 1983-84, the young were quite small and therefore placed in the release pens after the adults to prevent them from being trampled.

5)Tracking. Radio collars, markers, and tracking procedures have been improved.

Before The Capture

Preparation for the actual capture and release involves a June breeding bird survey of the Grande Prairie flock to select candidate pairs for transplanting and to assess total breeding pairs with nests. A pre-capture survey of candidate lakes is conducted 1 or 2 days prior to actual capture of the family groups.

The following criteria are used in selecting candidate swan families:

1)Both parents must be flightless;

2)They must have a minimum of four young;

3)The family should be found on the periphery of the Grande Prairie nesting populations;

4)High priority is given to previously captured adults and their young since they have already experienced the capture/release process.

Capturing the Swans

To capture the swans, a Bell 206 helicopter is used. The adults and young are flightless at this time of year. On approach, the swans hurry away and then cower as the helicopter closes in. Biologists use salmon nets to capture and lift the birds into the cabin of the helicopter. This entire operation takes from 2 to 4 minutes. Once the entire family is captured, they are flown to a central staging area. Here they are sexed, weighed, measured, adults are leg-banded, collared, and a sample of their blood taken. Finally, they are transferred to special crates for the trip to Elk Island by truck or aircraft.

The Release

Upon arrival at Elk Island National Park, the family groups are released onto four lakes in the southern part of the park. This area of the park is relatively undisturbed and contains habitat similar to the Grande Prairie area.

Surveillance

Once within the park, the swans are observed and monitored at frequent intervals by park staff using binoculars and radio-telemetry equipment. The radio collars have a transmission distance of 2 km surface-to-surface, 10 km surface-to-air and remain operational for up to 2 years. Juveniles of near-adult size are collared in the fall before they are able to fly. Aerial monitoring takes place during the fall and spring migration. A network of Canadian and American volunteers cooperates in the location and identification of transplants along the suspected migration route. USA biologists observe them on their wintering grounds.

II. RESULTS

The initial reintroduction effort at Elk Island, utilizing adult guide birds from coastal British Columbia and captive hatched cygnets from Grande Prairie was unsuccessful. Several factors are implicated in this failure, including early freeze-up, heavy coyote predation and disorientation of the adult guide birds. It has also been suggested, that by the time the transplant birds began migration, the mountain passes between Elk Island National Park and the Pacific were into full winter and migration would have been very difficult.

Although the second reintroduction, initiated in 1987, has also had difficulties (see Shandruk and Winkler 1989), at least two juvenile birds released at Elk Island National Park in 1987 returned to the park to summer in 1988. In addition, 8 unidentified trumpeters were observed at Beaverhill Lake (approximately 15 km to the east) in 1988. As no Trumpeter Swans have been sighted at Beaverhill since 1955 (Lister 1979), these could well have been led back by birds transplanted to Elk Island National Park in 1987 or earlier efforts.

It is also significant, that the 4 pairs of adult guide birds used in 1987 all returned as pairs to the Grande Prairie nesting area in 1988. Three of these pairs returned to the same lake on which they were captured the previous year. This is a clear indication that the capture and transplant of adult swans has little impact on their migratory traditions, and that the project has little impact on the long term breeding population in Grande Prairie.

The transplant project will continue in 1989. Some modifications to capture timing will be made to improve cygnet survival. Most importantly, capture will be delayed until mid-August. This will provide older cygnets which should be better able to adapt to the stress of capture and release into an unfamiliar area.

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HISTORY AND STATUS OF SASKATCHEWAN TRUMPETER SWANS

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Saskatchewan supports less than 1% of the Canadian population of Trumpeter Swans (*Cygnus buccinator*). Cypress Hills in the southwest corner of Saskatchewan remains the only area in this province with a known breeding population of swans. Records kept since 1951 document a fluctuating breeding population of 1 to 3 pairs producing between 2 to 7 cygnets per nest site. Reproduction was highest in 1971 and 1972 when 3 pairs produced 9 and 10 cygnets, respectively.

More recently only 1 pair are known to nest in Saskatchewan on Coulee Lake Reservoir in Cypress Hills Provincial Park. Assuming they are the same individuals, they have successfully fledged 3 cygnets in 1983 and 1984, 2 cygnets in 1985 and 2 cygnets in 1987. The nest and eggs were abandoned in 1986.

In the 1988 nesting season no cygnets were produced. The pair did appear to try and nest as the nesting platform was in good repair and the birds showed fidelity to the nest site. However, unlike 1986, no eggs were ever observed. This lack of nesting may be due to:

1)land based predators may have been able to get to the nest site owing to very low water levels;

2)One or both birds are new to the reservoir (i.e., newly formed pair and actual breeding did not occur - just initial bonding to breeding ground);

3)Reproductive senescence of birds.

Trumpeters were also observed at 2 other locations in 1988. Two white plumage trumpeters were observed from the air in May at the Hungurdford Lakes approximately 25 km southeast of Coulee Lake. These birds were never relocated in later surveys. A single white plumage bird moulted on Adams Lake Reservoir 2 km west of Coulee Lake. From 1 to 3 moulting birds have inhabited Adams Lake most years since 1983.

The core breeding habitat at Coulee Lake is within Cypress Hills Provincial Park and is therefore secure and protected. In the early 1980s habitat at Adams Lake was poor due to the lack of emergent and submergant shoreline vegetation. In 1986, Saskatchewan Parks Recreation and Culture cooperated with Ducks Unlimited Canada to improve water management. Two control structures were built, providing for more stable water levels and improved aquatic vegetation. Although habitat is improving, no nesting has occurred to date.

Aerial surveys of available habitat in southeastern Saskatchewan (east to Swift Current) have been flown from 1983 through 1986. Although some migrants and moulters have been located, no new nesting pairs have been found.

POPULATION DYNAMICS OF FERRUGINOUS HAWKS IN ALBERTA

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In response to a declining trend in the breeding range of Ferruginous Hawks (*Buteo regalis*) in Canada, this hawk was assigned threatened status by the Committee on the Status of Endangered Wildlife in Canada (Schmutz and Schmutz 1980). A long-term study was launched to monitor population changes and to evaluate the potential factors causing the decline. This study involved a study area south of Hanna in southeastern Alberta (Schmutz et al. 1980) and 80 41-km^2 study plots selected at random in that part of the province lying south of Hanna and east of Pincher Creek (Schmutz 1984, 1989). Nesting pairs were counted during thorough searches of the study areas using a motorcycle for transportation.

CHANGES IN THE NUMBER OF BREEDING FERRUGINOUS HAWKS OVER TIME

The numbers of Ferruginous Hawks that nested on the Hanna study area were remarkably stable between years except for a substantial increase in numbers in 1986. The size of the Hanna study area was 335 km^2 in 1975 and 1983 and enlarged to 480 km^2 in 1976/1977 and 1984 to 1989. The density of breeding pairs ranged from 9.8 to 11.3 pairs/100 km^2 in 1975 to 1977 and 1983 to 1985. The density increased in 1986, ranging between 13.3 and 14.0 pairs/100 km^2. Similarly, the number of breeding pairs on the study plots increased from an average of 0.59 pairs/plot in 1982 to 0.99 pairs/plot in 1987. The estimated size of the breeding population was 1082 breeding pairs in 1982 and 1772 breeding pairs in 1987. Confidence intervals associated with the estimate were wide because Ferruginous Hawks avoided plots with 50% or more cultivation and these plots were widely scattered throughout the study area. Ninety-five percent confidence intervals were 653 to 1511 pairs in 1982 and 1283 to 2261 pairs in 1987.

FERRUGINOUS HAWKS AND GROUND SQUIRREL PREY

The rise in Ferruginous Hawk abundance was correlated with an increase in the abundance of ground squirrels (*Spermophilus* spp.) in 1986 (Schmutz and Hungle 1989). A link between Ferruginous Hawk and ground squirrel abundance was also evident on the randomly selected study plots. Using the number of used ground squirrel burrows counted along a transect as an index of ground squirrel abundance, the number of pairs of Ferruginous Hawks declined where ground squirrels where scarce ($r_s=-0.649$, $P<0.001$ (Schmutz 1989)). The correlation between ground squirrel and Ferruginous Hawk densities is not surprising given that the Ferruginous Hawk's diet, at least during the nestling periods, consists almost exclusively of ground squirrels (86-92% of prey biomass (Schmutz and Hungle 1989)).

HABITAT OCCUPANCY

Ferruginous Hawks prefer to nest and experience greater reproductive success on sites where their nests are protected from mammalian predators compared to nesting on nearly level ground. Preferred nest sites include eroded banks, trees, or various other elevated sites including artificial nests and boulders (Schmutz et al. 1984, 1988).

Ferruginous Hawks were more common in areas where a small proportion of the land was cultivated compared to large blocks of grassland, presumably because ground squirrels were also slightly more common near agricultural crops. However, when more than 50% of the land was cultivated Ferruginous Hawks declined. This decline was probably not due to an absence of prey *per se* but because the number of ground squirrels in intensively cultivated areas was insufficient to support Ferruginous Hawks. Swainson's Hawks (*B. swainsoni*) were common in cultivated areas where they probably shifted to feed primarily on mice and voles.

In addition to cultivation, Ferruginous Hawks avoided areas of parkland habitat. There, trees cover a large portion of the land and Ferruginous Hawks are forced to compete with Swainson's Hawks and Red-tailed Hawks (*B. jamaicensis*) (Schmutz et al. 1980, 1990).

LIMITING FACTORS

The increase in the number of breeding Ferruginous Hawks in Alberta is consistent with an increase in the number of Ferruginous Hawks counted on Christmas Bird Counts in the southern United States (Warkentin and James 1988). Actually, the data suggest that a surplus of breeders existed during the 1980s. This evidence comes from several sources. First, although Ferruginous Hawks exhibited an increase in numbers starting in 1986, there was no evidence to suggest that reproduction had changed to account for this increase. Hence additional breeders that settled in 1986 were probably also available in 1985 and even a few years earlier. Second, in 1986 and 1987, seven dead adults were found within 200 m of nests. Judging from the state of decay, these adults died near the time of nest establishment. Although removed from the breeding population, these adults were replaced by other breeders and two adults defended a brood of young hawks at each nest (Schmutz et al. 1990).

If the data correctly indicate that a surplus of Ferruginous Hawks including individuals capable of breeding existed within the current breeding range in Alberta, this has important implications for the condition of Ferruginous Hawk habitat. By 1987, Ferruginous Hawks had expanded their breeding range by invading only a small portion of their previously vacated range. In some suitable areas within their range, Ferruginous Hawks had reached exceptional breeding densities (e.g., the Hanna study areas and some study plots), yet these hawks did not reoccupy all of their former range. This suggests that the vacated portions of the Ferruginous Hawks' range has been sufficiently modified so as to exclude these hawks permanently. Therefore, conservation action should be primarily directed at the currently occupied portion of the range. The continued existence of ground squirrels is crucial to conserving Ferruginous Hawks in prairie habitat.

Most Ferruginous Hawks from Alberta winter in western Texas (Schmutz and Fyfe 1987). In Texas, where Black-tailed Prairie Dogs (*Cynomys ludovicianus*) are active throughout the winter, Ferruginous Hawks are particularly common near prairie dog towns. Prairie dogs have been decimated in large numbers in the past (Regenstein 1975) and continue to be poisoned.

CONCLUSION

In summary, data which are briefly summarized here, and which reflect changes in the abundance of Ferruginous Hawks over time and differences in the hawks' distribution lead to the following conclusion. The breeding range of Ferruginous Hawks in Alberta has been reduced through habitat change including cultivation and the invasion of parkland into prairie habitat in the absence of naturally-occurring prairie fires. Within the hawks' current range, Ferruginous Hawks depend on suitable nest sites and ground squirrel prey. However, since Ferruginous Hawks spend at least 5 months of the year outside of Alberta, their conservation must include measures taken on the migration and winter range.

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FERRUGINOUS HAWK NESTING DENSITIES ON CLASS I AND II HABITAT IN SASKATCHEWAN

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INTRODUCTION

The Ferruginous Hawk (*Buteo regalis*), the largest North American buteo, inhabits prairie landscape from southwestern Manitoba, southern Saskatchewan and Alberta to southern California, Arizona, and Texas (Beebe 1974). This species, designated as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), nests in farmyard shelterbelts, lone trees, coulees, and on river banks (Schmutz and Schmutz 1980). Man-made structures such as artificial platforms, power poles, and haystacks also receive some use. In Alberta, the Richardson's Ground Squirrel (*Spermophilus richardsonii*) is the major prey item in terms of total biomass and frequency (Schmutz 1977).

Historically, the Ferruginous Hawk nested regularly on the Great Plains of southern Saskatchewan and Alberta. However, by 1960, the Saskatchewan population plummetted to 10 to 20% of its presettlement levels due to several factors including the decline of prey species populations, the increase of aspen parkland, and the change in land use practices (Houston and Bechard 1984). To aid in the management of the Ferruginous Hawk, the Saskatchewan Natural History Society proposed a study to gather management-oriented data such as the nesting density of the population in habitats with the greatest percentage of native vegetation.

STUDY AREA

The biotic regions surveyed include the Cypress, Great Sand Hills, Old Wives, Missouri Coteau, South Saskatchewan River and Wood Mountain (Fig. 1). We surveyed only Class I and II habitats. Class I habitats have 90 to 100% native vegetation and introduced

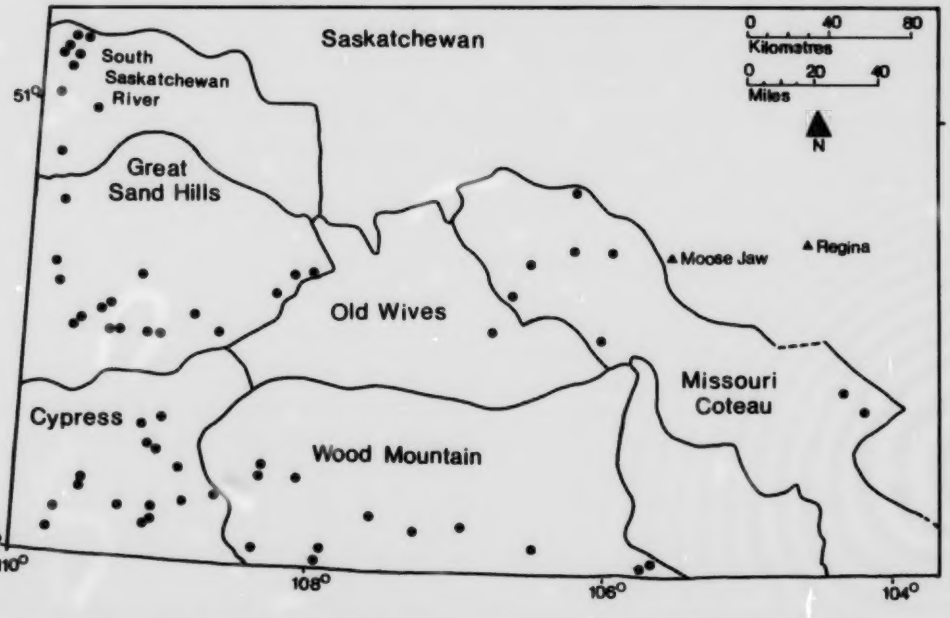

Figure 1. The study area outlining the biotic regions surveyed and locations of occupied Ferruginous Hawk nests. Nest locations are represented by dots.

perennial forage crops while Class II habitats have 50 to 90% native vegetation and introduced perennial forage crops (Saskatchewan Tourism and Renewable Resources, Wildlife Research Division 1976). All these biotic regions form part of the Great Plain (Richards and Fung 1969). Here precipitation amounts to 30 to 51 cm annually and temperatures vary from 0° C to 6° C resulting in a short growing season. Short-grass mixed prairie predominates throughout except in the elevated parts of the Cypress region. In these marginal soils and at lower elevations, aspen (*Populus tremuloides*) grow in small clumps in coulees, on hillsides, and in farmyards; conifers grow at higher elevations.

Unimproved pasture land predominates in most hilly areas while crops grow on flat land. Except for the humid continental area in the Cypress uplands, the mostly semi-arid to sub-humid characteristics of these regions with internal drainage basins and some lakes and rivers, many intermittent, limit the variety of crops grown and often require the use of special conservation practices. Here the potential water loss through evaporation exceeds precipitation.

METHODS

Dale Hjertaas, past president of the Saskatchewan Natural History Society, divided the Ferruginous Hawk's breeding range into nine major biotic regions of which we surveyed six. Eunice Bergstrom of the Saskatchewan Wildlife Branch chose survey plots for the first 2 years and I chose the plots for the third year. All plots originated from only Class I and II lands.

To avoid unnecessary disturbance early in the breeding cycle, binoculars and a spotting scope helped determine nest occupancy (Fyfe and Olendorff 1976). We surveyed plots by air, foot, truck, and mountain bike; later we ground-truthed occupied nests found during aerial surveys. All trees were searched for nesting hawks. In hilly areas, researchers walked the top and bottom to locate and assess the contents of any nests present.

The "term occupied" nest defined for this study includes any nest at which either eggs were laid, young were raised, one adult was presumed incubating or two adults were on or near the nest (Postupalsky 1974). Because plots of this study were of unequal size and shape and were chosen nonrandomly, the jackknife procedure proved most applicable to generate variances (Sokol and Rholf 1981). This procedure generates variances based on the variance of all possible densities obtained by omitting one sample plot at a time from a pooled density variance.

RESULTS AND DISCUSSION

During this 3-year study, we surveyed 205 plots totalling 5110 km^2, approximately 2.3% of the Ferruginous Hawk's former range and 3.4% of its present range. Class I and II habitats make up 74% of the area of the Cypress region but only 9% of the area of the Old Wives region; however, the South Saskatchewan River region had the largest percentage of its Class I and II habitat area surveyed, 32.5%, with the Old Wives region a close second (Banasch 1989, 1990). An adequate minimum hunting area for one pair of Ferruginous Hawks covers 16 km^2 (Dale 1986). The mean area for the plots surveyed in all regions exceeded this figure except in the Old Wives region.

Table 1. Density of occupied nests in Class I and II habitats by biotic region.

	Occupied Nests			
Biotic Region	Total Number	Density /100 Km^2	Density Variance	95% C.I.
Cypress	15	1.58	7.74	0.734-2.386
Great Sand Hills	17	2.18	8.70	1.201-3.039
Old Wives	1	0.35	2.28	-0.401-1.101
Missouri Coteau	8	0.98	4.92	0.306-1.654
South Saskatchewan River	9	1.15	4.68	0.181-2.099
Wood Mountain	12	0.82	2.49	0.250-1.370

The density of occupied nests varied from 0.35/100 km^2 in the Old Wives region to 2.18/100 km^2 in the Great Sand Hills region (Table 1). The data from the Cypress, Great Sand Hills, and South Saskatchewan River regions compare favorably with data from Alberta (1.5/100 km^2 (Schmutz 1984)) and Utah-Idaho (2.5/100 km^2 (Howard and Wolfe 1976)). However, other studies in North Dakota (5-8 pairs/100 km^2 (Gilmer and Stewart 1983)), and in Saskatchewan (12.51 pairs/100 km^2 (Houston 1979)) show higher densities. These originate from areas of high Ferruginous Hawk nesting densities and do not reflect average densities throughout the range.

Comparing data collected during this study to that of Houston and Bechard (1984), we find that nests located in the Cypress, Great Sand Hills, and South Saskatchewan River regions occur in the same parts of the historical range but in larger numbers. The Old Wives region data appear unchanged. Only in the Missouri Coteau and in the Wood Mountain region did we locate nests in new areas.

CONCLUSIONS

During the 3-year study, we surveyed only Class I and II habitats, areas that presumably contain the best Ferruginous Hawk nesting and prey species habitats. The Old Wives region showed the lowest nesting density, 0.35 occupied nests/100 km^2, and the Great Sand Hills region the highest, 2.18/100 km^2. Compared to Houston and Bechard (1984), these data indicate that nesting densities increased within the previously occupied parts of the historical range in the Cypress, Great Sand Hills, and South Saskatchewan River regions. The Old Wives region data remained unchanged. Only in the Missouri Coteau and Wood Mountain regions did we find nests in areas previously unoccupied.

ACKNOWLEDGMENTS

Geoff Holroyd provided support and comments throughout the study. Rick Jerema did the majority of the 1986 fieldwork. Enid Cummins and Sam Barry volunteered time in 1987. Mike Quinn and Sam Barry provided field assistance in 1988. I thank the numerous people who prepared maps and figures and who provided drafting and statistical advice. The Saskatchewan Natural History Society, through World Wildlife Fund Canada, and Canadian Wildlife Service funded this project.

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STATUS, HABITAT REQUIREMENTS, AND ADAPTATIONS OF FERRUGINOUS HAWKS IN MANITOBA

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INTRODUCTION

In 1984, Ratcliff and Murray (1984) located a Ferruginous Hawk (*Buteo regalis*) nest in southwestern Manitoba, the first known nest record in the province in 57 years. During 1985 and 1986, two to three active nests were found annually (Ratcliff 1987, pers. comm.). In 1987 and 1988, intensive surveys were conducted in grasslands of southern Manitoba for Ferruginous Hawks and other threatened and endangered species through a cooperative effort between the Manitoba Department of Natural Resources, World Wildlife Fund Canada, and the Manitoba Naturalists Society. This report discusses the status and habitat requirements of Ferruginous Hawks in Manitoba and adaptations that have allowed them to recolonize prairie/parkland areas in their former range.

METHODS

Study areas were selected by reviewing computerized data on the distribution of grasslands in southern Manitoba. Forest inventory maps were obained for townships that had abundant grasslands (i.e. pastures, haylands, and prairie) and these were used to plan routes and as field sheets. Grassland areas on these maps were identified. These areas were searched for large nests and/or Ferruginous Hawks by driving along section-line roads and trails and scanning over or accessing extensive grassland areas wherever possible. Locating nests was facilitated in 1988 by starting field work in mid-April when pairs were active near nest-sites and when nests were not yet hidden by leaves. To guard against desertion, active nests were not approached during the prenesting or incubation period. Young were banded with aluminum bands in 1987 and with aluminum bands plus a black and white alpha-numeric anodized aluminum band in 1988. Sixteen immatures were banded in 1987 and 43 immatures were banded in 1988.

DISTRIBUTION

During 1987, 11 nests were found; all were in the extreme southwest from Broomhill to Lyleton. Ferruginous Hawks were observed in 23 other townships north to St. Lazare and east to Ninga. During 1988, 32 nests were found north to Lenore and Rivers and east to Shilo, Treesbank, and Hilton. Adults were also observed in 17 other townships during the breeding season north to St. Lazare and east to Oak Hammock Wildlife Management Area, north of Winnipeg.

HABITAT AND NEST SITES

All nests during this study were in trees and shrubs including 11 in Trembling Aspen (*Populus tremuloides*), 10 in Eastern Cottonwood (*Populus deltoides*), nine in Manitoba Maple (*Acer negundo*), seven in willow shrubs, four in Elm (*Ulmus americana*) and two in Green Ash (*Fraxinus pennsylvanica*) (Table 1). Nest heights averaged 6.5 m (21 ft). Nests in cottonwood were especially high, averaging 10.5 m (34.5 ft), including three that were between 13.1 and 14.3 m (43-47 ft) high. Nests in aspen averaged 7.3 m (24 ft), at least 2 m higher than average heights in any other tree species except cottonwood. It was also interesting to note that nests in cottonwood and aspen fledged twice the average number of young fledged in other trees or shrubs. Nests were usually in isolated or scattered trees but some were inside dense aspen bluffs and offered limited visibility of the surrounding terrain.

Although Ferruginous nests are normally very large structures, some in Manitoba were unusually small and inconspicuous. Our original impression of Ferruginous Hawk nests, large, low nests far from any roads, was quickly changed. Although one of the nests in cottonwood was low and bulky, most nests in cottonwoods were considerably higher, narrower, and shallower than the norm and were located out on a limb rather than in a major fork of the tree. During this study, about 10% of the nests were within 100 m

Table 1. Ferruginous Hawk nest site selection and nesting success in southern Manitoba, 1987 and 1988. Sample sizes, where different from number of nests, in parentheses.

Tree Spp.	No. Nests	Ave. nest height (m)	Ave. nest width (cm)	Ave. nest depth (cm)	No. young fledged/nest
E. Cottonwood	10	10.5	75.2	50.5	2.3
Trembling Aspen	11	7.3	81.1(9)	54.7(9)	1.7
American Elm	4	5.1	85.1	56.5	1.5
Manitoba Maple	9	4.5	82.1(7)	65.6(7)	0.4
Willow Shrubs	7	3.9	83.5(6)	53.7(6)	1.0
Green Ash	2	3.5	66.1	50.8	1.0
Cottonwood & Aspen	21	*8.8*	78.9(19)	52.5(19)	*2.00*
Others	22	*4.3*	81.5(19)	58.4(19)	*0.84*

and 75% within 800 m (1/2 mile) of a road or maintained trail.

In Alberta, Schmutz (1984) found that 30% of the surrounding area can be cultivated before Ferruginous Hawk populations are adversely affected. In Manitoba, productivity was not affected by increased cultivation near Ferruginous Hawk nests. On the contrary, successful nests had more cultivated land and less pasture nearby than did failed nests. In Manitoba, 47% of the nests had more than 30% cultivation within 1 km and 78% had more than 30% cultivation within 2 km. In fact, about one in five nests were surrounded by more than 50% cultivated land within 1 to 2 km and 6 to 9% were surrounded by more than 75% cultivation! One nest was unique in that it was situated in a small bluff in the middle of a cultivated field; it was surrounded by cultivated land and headlands for more than 1 km and had few suitable grasslands and none more than 1/2 section in extent for at least 10 km. Nevertheless, this pair raised two young. Another nest which fledged four young in 1987 and five young in 1988 was located in an alfalfa field with no pasture within 0.5 km and only 25% pasture (60% cultivated) within 2 km of the nest.

STATUS AND ADAPTATIONS

Whether or not Ferruginous Hawk populations have expanded in Manitoba during the 1980s is open to speculation. Perhaps some were present but overlooked prior to the 1980s. Although increases have undoubtedly taken place, their magnitude is unknown. We estimate the current nesting population in Manitoba to be between 40 and 50 nesting pairs. The species should remain in the threatened or endangered category in Manitoba.

We are intrigued at evidence that Ferruginous Hawks may be adapting to changing conditions on the prairies, particularly the invasion of aspen onto the prairies and fragmentation of remaining habitat. Evidence of this includes (1) increased use of high nests and elevated nesting success in these high nests, (2) greater than expected use of, and nesting success in, extensively cultivated areas, (3) use of artificial nesting structures (Two of 64 installed by Brandon regional staff during 1987 were used in 1988. This was funded by the Manitoba Habitat Heritage Corporation.), (4) nesting by many pairs near roads or within small but dense aspen bluffs, (5) greater than expected use of aspen (Among 361 tree nests in central North Dakota, Gilmer and Stewart (1983) found none in aspen. In Manitoba, aspen were used more frequently than any other tree species.) and, (6) extensive feeding on Northern Pocket Gophers (*Thomomys talpoides*) (More than one-third of the food items found in nests during 1988 were of this species. This suggests frequent use of habitats other than pasture for hunting purposes.). These adaptations may be important for Ferruginous Hawks inhabiting prairie/parkland habitat in northern portions of their range and may be contributing to recent increases in Manitoba, Saskatchewan, and Alberta.

MANAGEMENT CONCERNS

The sensitivity of Ferruginous Hawks during the nesting season has been well documented. Nevertheless, many studies incorporate visits to nests during late incubation to obtain nesting information; these studies rarely report abandonment due to observer disturbance. Although we would have liked to get information on nests during late incubation, visits were delayed until young were in the nest. When nests were first visited in the second week in June, most had well-developed young; later, however, some nests had young that were very small or were just hatching out. Although we anticipated no problems since this should be when adults would be most attached to nests, two nests with young were subsequently abandoned. Circumstances suggested these pairs may have abandoned due to our visits. These findings indicate a need for better documentation of abandonment rates and causes and additional precautions when studying this species.

We also were concerned about telling landowners about the location of nests. Although it is important to have the landowners aware of the situation and most seemed sympathetic to the plight of Ferruginous Hawks, we felt visits by them, their children, or someone else who found out about the location of these nests through us jeopardized the nests. In one case, we were appalled to find rocks in a isolated nest. Upon talking to the landowner, who was very supportive of the project, we found out that his sons and their friends had probably been involved in the vandalism. Other nests that were abandoned or destroyed under suspicious circumstances left us wondering if it was better if few people knew exactly where the nests were located; we preferred to present locals with fact sheets on the species and to indicate what we were doing and that the species had been seen in the area.

Young falling out of nests or nests tipping or falling in storms accounted for a majority of the losses incurred in Manitoba during 1987 and 1988. These losses can probably be reduced through provision of sturdy artificial nest structures near active nests and reinforcement of unstable nests or nesting trees. Specific sites where these measures should be considered are outlined in a recent report (De Smet and Conrad 1989).

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FERRUGINOUS HAWK NESTING SUCCESS: A 19-YEAR STUDY

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A 63.5 km^2 government pasture, containing 10 shelterbelts of farms abandoned in the late 1930s, has been studied for 19 years. Decaying trees in these shelterbelts offer prime breeding habitat for the Ferruginous Hawk, *Buteo regalis*. The most successful site is a lone maple tree, *Acer negundo*, from which 66 Ferruginous young have been fledged in 19 years. Prior to this, the pasture manager observed an additional 9 years of success, for a total of 28 consecutive years with young fledged.

Five of six platforms erected on the less treed portion of the pasture in 1972 have since been used irregularly, but twice have brought the number of successful pairs in the pasture to nine, one of the heaviest densities recorded for this species.

The nests on this pasture have a higher success rate and produce more young per nest than those of surrounding areas where more isolated pairs show only sporadic success.

There has been a general tendency towards an increase in the number of active Ferruginous Hawk nests on this pasture (Table 1).

TABLE 1. Ferruginous Hawk Nesting Success on Kindersley-Elna Pasture, 1971-1988.

Year	# Pairs Nesting	# Nests Failed	# Nests Fledged	Total # Young	Fledged nest Ratio	# Nesting Poles Used
1971	6	1	5	15	3.0	
1972	5	0	5	16	3.2	
1973	6	3	3	6	2.0	0
1974	9	3	6	22	3.7	1
1975	5	1	4	16	4.0	1
1976	6	1	5	17	3.4	1
1977	9	0	9	30	3.3	3
1978	7	1	6	20	3.3	1
1979	7	2	5	20	4.0	2
1980	7	0	7	15	2.1	2
1981	7	0	7	21	3.0	2
1982	7	0	7	23	3.3	0
1983	7	2	5	16	3.2	0
1984	7	0	7	23	3.3	0
1985	8	0	8	27	3.4	0
1986	9	0	9	26	2.9	0
1987	9	0	9	30	3.3	1
1988	9	2	7	22	3.1	0
total	130	16	114	365	3.2	14

FALCONS AND PRAIRIE CONSERVATION

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Birds of prey, because of their position at the top of the food chain, are highly sensitive to environmental contaminants or changes in habitat. They can therefore serve as important health indicators for the ecosystems of which they are a part. All five species of falcons found in Canada occur on the prairies. While of these only the Peregrine Falcon (*Falco peregrinus anatum*) is listed as endangered, it is worth considering the status of the other four species as well.

AMERICAN KESTREL (*Falco sparverius*)

This is the smallest and by far the most common of our falcons and breeds throughout Canada south of the treeline. The kestrel is a relatively uncommon breeder on the prairies in comparison to other habitats, being restricted to suitable riparian areas where trees are larger and contain cavities for nesting or there are small "potholes" in cliff faces. Over the past century, man-made structures such as barns, granaries, billboards, etc. have sprung up on the prairies providing additional sites for nesting. At present, this species is of no particular concern to the Prairie Conservation Action Plan (PCAP). However, kestrels would certainly respond to the provision of nest boxes in a similar way to the Mountain Bluebirds (*Sialia currucoides*) and Tree Swallows (*Tachycineta bicolor*) which now nest across the prairies.

MERLIN (*Falco columbarius*)

One subspecies of this much rarer small falcon has a very restricted breeding range that coincides almost exactly with the northern prairie and parkland (Clark and Wheeler 1987). Although there was much concern over the apparent declines in prairie Merlin populations in the late 1960s and early 1970s (Fox 1971), current population levels and breeding success suggest a healthy population (Oliphant and Thompson 1979, Oliphant 1985). One of the most striking adaptations of the Merlin has been the colonization of cities and towns of the Canadian prairies. Merlins, like other falcons, do not build nests of their own and utilize crow and magpie nests, which in cities are usually in ornamental spruce trees (Houston and Schmidt 1981, Oliphant and Haug 1985). In the last few decades, greater numbers of Merlins have remained on the Canadian prairies over winter, often in urban areas (James et al. 1987). The continued success of the Merlin outside these urban areas will of course depend on the maintenance of adequate breeding sites (trees in riparian areas, shelterbelts, etc.) and hunting areas.

PRAIRIE FALCON (*Falco mexicanus*)

This large "desert falcon" has been identified as a bird of concern in the PCAP. Like the prairie race of the Merlin, the Prairie Falcon is an endemic prairie species with a restricted breeding range. The total Canadian breeding population of this species is unlikely to exceed a few hundred breeding pairs. The Prairie Falcon nests exclusively in "potholes" and on ledges of cliffs. Nesting habitat is therefore primarily limited to the badland areas and cliffs along major drainage systems in southern Alberta and Saskatchewan. A few Prairie Falcons also breed in the dry eastern areas of British Columbia. The relative rarity of this species was shown by a 1958 survey of two of the best nesting areas in Saskatchewan in which only five pairs were found (Fyfe 1958). There was great concern over reported population declines during the 1960s (Fyfe et al. 1969). More recent surveys suggest a rather healthy population (Oliphant et al. 1976) although there appears to have been rather dramatic decreases in numbers of breeding pairs in some areas since the mid-1970s. Richard Fyfe and his co-workers, and later members of the Saskatchewan Falconry Association, initiated projects to help this species by digging artificial holes in cliff faces to provide more nesting habitat. There is great potential for such a project in the Grasslands National Park where there are suitable cliffs but very few nesting holes. With very little effort, we should be able to insure nesting Prairie Falcons in the Park that could be easily seen by visitors. Such sites could become major focal points for park interpretation. A status report should be prepared for this species.

GYRFALCON
(*Falco rusticolus*)

This, the largest of the falcons, breeds throughout the Canadian arctic. The Gyrfalcon, although not a common bird, does not appear to be threatened or endangered (Cade 1982). We know very little, however, about its wintering ecology. Gyrfalcons appear regularly on the Canadian prairies in the winter and these birds possibly represent a significant proportion of the population. Adequate habitat and good populations of prey species such as Sharp-tailed Grouse (*Tympanuchus phasianellus*) and Gray Partridge (*Perdix perdix*) are undoubtedly necessary for these birds to survive through the winter.

PEREGRINE FALCON
(*Falco peregrinus anatum*)

This is the most widespread of any falcon in the world, breeding on every continent except Antarctica and on most of the major islands. It is not typically thought of as a "prairie species," generally nesting along major rivers or in coastal areas, but has been known to nest in a wide variety of habitats including the badland areas of the prairies. The main concern for the peregrine in North America focuses on the *anatum* subspecies which formerly bred throughout much of the continental U.S. and southern Canada. It underwent drastic population declines associated with the widespread use of DDT and was declared endangered after a major meeting to discuss the plight of the peregrine was held in Wisconsin in 1965 (Hickey 1969).

The activity that has followed the Wisconsin meeting has been unprecedented. The Raptor Research Foundation, which is now nearly 1000 members strong and with its own journal, was founded primarily to develop techniques for breeding Peregrine Falcons in captivity. Two major breeding projects, one at Cornell University (The Peregrine Fund) and the other at Wainwright, Alberta (Canadian Wildlife Service), were established and have produced hundreds of peregrines for release over the past two decades. Recovery teams were established both in the U.S. and Canada to oversee the reintroduction effort. The success of this program has been unequaled in terms of the short time span in which the necessary techniques were developed and implemented and also the successful establishment of breeding birds in the wild. The Sacramento Conference on the Management and Recovery of Peregrine Falcons was held in 1985 (Cade et al. 1988), just 20 years after the Madison Conference on their Biology and Decline.

In the eastern U.S. in 1989 at least 94 pairs were known to be present from New York to North Carolina. The situation in Canada is less certain as monitoring of returning birds is not carried out as intensively as in the U.S. Nevertheless something on the order of 20 pairs of peregrines were known to be present in southern Canada and many of these have been identified as birds released as part of the reintroduction program.

The Peregrine Falcon Recovery Plan was the first Canadian recovery plan for an endangered species to be ratified by the Provincial Directors of Wildlife, and along with that of the Whooping Crane (*Grus americana*), represent the only two recovery plans currently prepared. A major goal of the recovery plan is to establish a minimum of 10 territorial pairs in each of the six designated geographic areas. The prairie region is contained within zone three which in 1989 had possibly as many as six territorial pairs. These were all located in cities (Edmonton, Calgary, Saskatoon, Regina, and Winnipeg). Young have been successfully produced in Edmonton, Calgary, and Winnipeg.

Major changes in the physical environment on the prairies, such as the creation of Lake Diefenbaker and wetland complexes associated with the Heritage Marsh program and North American Waterfowl Management Plan, are creating new habitat that may well prove suitable for the peregrine. Hopefully we are in the final stages of seeing the return of the peregrine as a minor, but rather spectacular part of the wildlife of the Canadian prairies.

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NEW ASPECTS OF BURROWING OWL BIOLOGY

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As a threatened species in Canada, the Burrowing Owl (*Athene cunicularia*) faces one or more limiting factors which have to be identified, understood,and then altered. The identification of potential limiting factors is relatively straight forward and has, for the most part, been accomplished (Wedgwood 1978). Some limiting factors, such as habitat loss and low populations, have been addressed with the implementation of Operation Burrowing Owl in Saskatchewan and Alberta and with owl reintroductions in British Columbia and Manitoba. However, even in 1989, our understanding of limiting factors in the biology of this species is quite rudimentary. Field research is the vehicle by which we gain this understanding, without which conservation efforts are doomed to failure. In 1986, a long-term study of Burrowing Owls was initiated on the Regina Plains (James and Fox 1987). We briefly report here some further results from this project.

STRYCHNINE AND BURROWING OWLS

Rodenticides have been identified as a potential limiting factor for Burrowing Owls. In 1988, we evaluated the potential impact of the use of strychnine-coated grain to control ground squirrels by comparing various aspects of owl reproductive biology between experimental (poisoned) and control pastures. Adult owl survival, breeding success (percent of pairs producing at least one chick), breeding productivity (number of chicks produced per successful nest), and chick weights were not significantly different between poisoned and control pastures. However, adult owl weights were significantly higher on the control pastures. We concluded that the use of strychnine-coated grain, when applied as per label instructions to control ground squirrels, is not detrimental to breeding Burrowing Owls in the short term. The lower adult weights on the poisoned pastures, however, may be indicative of a sublethal impact as many microtine rodents were also killed by the treatment, possibly resulting in a depleted food base. In addition, long-term reduction in ground squirrels will probably have a significant impact on the owls as most of them rely on ground squirrel holes for nesting.

HABITAT SELECTION BY BURROWING OWLS

A little is known about habitat selection of Burrowing Owls in the U.S. (Rich 1986, Green and Anthony 1989) but nothing is known in Canada. Such knowledge not only helps to pinpoint apparently suitable but unused pastures for protection but also assists in the management of unsuitable vacant pastures. The information is also critical because the remaining pastures in southern Saskatchewan are being cultivated at a rate of 3% per year (Hjertaas and Lyon 1987). We therefore compared various physical and biotic parameters between pastures and holes occupied and unoccupied by owls. Univariate analyses revealed that occupied pastures were more likely to be grazed and had a greater density of ground squirrel holes than unoccupied pastures. Occupied nest holes were more likely to be on level ground than. Multivariate discriminant function analyses indicate highly significant separations between occupied and unoccupied pastures and holes suggesting that Burrowing Owls are not nesting at random with respect to these features of their habitat.

BURROWING OWLS ON CHRISTMAS BIRD COUNTS

In order to gain some insight into long-term population changes in Burrowing Owls, we analyzed their occurrence on Christmas Bird Counts from 1954 to 1986 (James and Ethier 1989). Overall, their relative numbers on these counts have remained stable. However, there has been a significant decline since the mid-1970s. In addition, the wintering population in California has declined significantly while the Florida population has increased significantly. Populations in other states and Mexico have remained stable.

ACKNOWLEDGMENTS

We acknowledge the financial support of Pestfund (Canadian Wildlife Service), Wildlife Toxicology Fund (World Wildlife Fund), and FMC Canada.

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BURROWING OWL SURVIVAL

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WHY STUDY BURROWING OWL SURVIVAL?

In many parts of prairie Canada, the loss of grassland has been identified as a primary factor for the Burrowing Owl's (*Athene cunicularia*) decline (Wedgewood 1978). In the Hanna area of southeastern Alberta, Burrowing Owls, according to landowners, have been gradually declining in abundance for several decades. This decline has occurred despite the fact that our study population produced an above average number of young to fledging and that grazing is the dominant land use with only approximately 15% of the land under cultivation.

We launched a study to document the survival of breeding Burrowing Owls between years as an alternate factor reducing Burrowing Owl populations. It is conceivable that the owls' habitat or food on the migration or wintering ground is limiting survival. Too few owls may be able to return to occupy all available habitat in Canada. We hope to first compare the rate of survival with the rate obtained from other studies and for other birds to evaluate the potential threat arising from overwinter mortality. Second, once sufficient recovery data are available, we hope to compare adult and juvenile survivorship rates to evaluate whether the Burrowing Owl population is stable in the long term given existing rates of reproduction and survivorship.

BURROWING OWL RETURN RATES

Of 55 adult Burrowing Owls banded in 1986 and 1987 widely scattered over a large study area, we recaptured only eight in 1988. An additional four owls were banded but not captured at sites where owls were banded previously. We assumed that these four owls were those previously banded. The 12 owls were faithful to their former nesting area. Eleven owls nested within 100 m from their previously used nest and one owl moved 250 m away.

We hope to continue this study to document the normal pattern of nest site fidelity exhibited by owls. Having established this pattern of movement, we plan then to correct our minimum survival estimate obtained through banding and recapture and account for those owls that may have moved away.

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IMPACT OF GRASSHOPPER SPRAYS ON BURROWING OWLS IN SASKATCHEWAN

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The Burrowing Owl (*Athene cunicularia*) has been designated as a threatened species in Canada that is likely to become endangered with immediate extinction owing to the actions of man, if the factors affecting its vulnerability are not reduced. A progressive decline in numbers has been noted in recent decades but the causes have not been identified. A bird of the prairies, this small owl feeds extensively on small rodents and grasshoppers and is usually associated with areas where cereal and forage crops are grown. Two-thirds of the Canadian breeding population is thought to reside in Saskatchewan where agronomically significant grasshopper outbreaks of varying geographic extent have occurred in 37 of the 68 years from 1919 to 1985. Six major outbreaks have lasted 3 to 14 years. Where chemical agents are used for grasshopper control, there is potential for Burrowing Owls to be exposed.

In 1986 and 1987, the Canadian Wildlife Service commissioned field studies to determine the impact of operational grasshopper spraying on reproductive success of Burrowing Owls nesting in southern Saskatchewan (Fox et al. 1989).

METHODS

Two study areas were selected which were expected to have moderate to severe grasshopper infestations in 1986: (1) the heavily cultivated area surrounding Regina and (2) an area of predominantly rangeland near Val Marie. Active owl burrows were located during late May and early June and repeated visits were made at these sites to determine the maximum number of young to appear above ground.

Landowners, land managers, and local governments provided details of their grasshopper control measures including the date, location, and agent applied. In a recent study using radiotelemetry, 60% of the flights from the nest burrow were within 50 m and 90% within 400 m. Therefore any spraying event which occurred within 400 m of an active burrow was regarded as a potential exposure. The treatment groups were chosen a posteriori based upon the relative numbers of burrows exposed. See Fox et al. (1989) for a more complete description of methods.

RESULTS

Exposure

Ninety-eight percent of all Burrowing Owl nesting sites in Saskatchewan occur in crop districts where the grasshopper infestation in 1985 and 1986 were forecast to be moderate at least and potentially needed control. Although the infestation was less severe than in 1985, an estimated 7 million acres (2.8 million ha) were sprayed with insecticides in 1986 to control grasshoppers.

Only 23 of 99 nesting pairs on our study areas were not subjected to at least one spray event within 400 m of their nest burrow in 1986. A total of six different insecticides were applied within 400 m of one or more burrows. Carbofuran (Furadan) and carbaryl (Sevin) each accounted for 35% of the applications. Seventy percent of the exposures were within 50 m of the nest burrow. In all, five roadside applications by municipalities exposed a total of 60 burrows on 19 farms. Thirty-nine percent of the burrows exposed were subjected to three or more spray events (maximum = 8). Ninety-three percent of the exposures occurred before the young were first seen above ground; most occurred in late incubation or shortly after hatching.

Impact on Owls

Exposure to any agent other than carbofuran had little effect on productivity, regardless of the proximity to the burrow. Exposure to carbofuran resulted in significant reductions in productivity which increased with proximity of the application to the burrow ($P < 0.01$). This did not occur with carbaryl.

Exposure to carbofuran within 50 m of the nest burrow but without the burrow having been oversprayed resulted in a 17% reduction in brood size and a 27% reduction in nesting success relative to all burrows exposed to an insecticide other than carbofuran. Direct overspraying of the burrow resulted in a 83% reduction in brood size and a 87% reduction in nesting success.

Of the 12 pairs under observation where the burrows were directly oversprayed, eight (75%) failed and a minimum of 12 (50%) of the adults disappeared after spraying. Only one pair (14%) was present in 1987 on sites where seven pairs were oversprayed in 1986. In contrast, only two of 14 burrows (14%) oversprayed with carbaryl in 1986 failed completely and nine pairs (64%) were present in 1987 where 14 were present in 1986. These reoccupancy rates may be compared to the overall rate between 1986 and 1987 of 71% at the seven unexposed sites on the study areas.

THE NEED FOR REMEDIAL ACTION

In areas/years of moderate to severe grasshopper infestations, Burrowing Owls nesting in Saskatchewan are very frequently exposed to insecticides. Of the six insecticides currently in use, only carbofuran had a significant impact on the reproduction and survival of the owls. Overspraying nest burrows with carbofuran resulted in the disappearance of adults and reduced both the chances that a site would be reoccupied and the number of pairs present in the following year.

Given the extensive overlap between agronomically significant grasshopper infestations and this owl's breeding distribution and its propensity to forage in alfalfa fields, the continued use of carbofuran to control grasshoppers and alfalfa pests will impact a large proportion of the breeding population. Since 80 to 90% of all known Burrowing Owl nesting sites in Saskatchewan are on private land, it is vitally important that these landowners are made aware of the hazards this insecticide poses to this threatened species. Similarly, since roadside applications by local governments result in exposure of a large number of burrows, local governments must also be informed. The Saskatchewan landowners enrolled in Operation Burrowing Owl, on whose land over 700 pairs nest, have been notified of our findings. Landowners in Alberta and Manitoba should also be informed as well as relevant local governments in all the Prairie Provinces.

In view of its impact on this threatened species and of the fact that several alternative products exist and are in widespread use for this purpose, we believe the use of Furadan 480F for the control of grasshoppers and alfalfa pests in the Prairie Provinces poses an unacceptable and unnecessary risk to the survival of the Burrowing Owl in Canada. Therefore the Canadian Wildlife Service has advised Agriculture Canada to ban the use of Furadan for all uses against grasshoppers and all uses against alfalfa pests as of 15 September 1988. As a result of this advice based on the data presented in Fox et al. 1989, Agriculture Canada has instituted a restriction for the use of carbofuran formulated as Furadan 480F. This action, implemented as a supplementary label, prohibits the use of Furadan 480F within a minimum of 250 m of an occupied Burrowing Owl burrow. This regulatory decision represents a negotiated position in which several mitigating options were considered. These options ranged from instituting various setback distances ranging from 50 m where effects on Burrowing Owls were seen, to 400 m, the active foraging range of the owl, to Environment Canada's recommendation for extensive geographic restrictions in use.

In addition to this resriction, effective June 1989 Agriculture Canada is announcing a special review of all uses of flowable and granular formulations of carbofuran because of Environment Canada's concerns about its potential impact on birds. A regulatory decision is expected in the summer of 1992.

Since there is potential use of carbofuran during the breeding seasons of 1990, 1991, and 1992 before any further regulatory action is taken by Agriculture Canada, there is an urgent need to inform landowners, local governments, the P.F.R.A. and other corporate landowners, agricultural extension specialists, and spray applicators of our findings. Can you help?

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REINTRODUCTIONS OF BURROWING OWLS (*Athene cunicularia*) TO THE SOUTH OKANAGAN VALLEY, BRITISH COLUMBIA
(1983 TO 1988)

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In Canada, the Burrowing Owl (*Athene cunicularia*) occurs as a breeding species in Manitoba, Saskatchewan, Alberta, and British Columbia, primarily in open grassland habitats (Wedgwood 1978). This species has been designated as threatened nationally due to population declines (Haug 1989). The British Columbia population is geographically isolated from the prairie population by the Rocky Mountains and is designated provincially as endangered.

In British Columbia, breeding birds have been recorded in the South Thompson, Okanagan, and lower Similkameen Valleys (Howie 1980) and on Lulu Island (Butler and Campbell 1987) (Fig. 1). Burrowing Owls were locally common in suitable habitats just prior to the turn of the century. Population estimates are not available for this time period but maximum numbers are thought to have been relatively low, perhaps never more than a few dozen breeding pairs in any single year (Bryant 1990). A sharp population decline occurred in the early 1900s. The birds nested "sporadically in the 1930s, '40s, and '50s" but few nests have been reported since then; single birds are still observed, although irregularly (Howie 1980).

Habitat loss and declines in the Yellow Badger (*Taxidea taxus*) population, upon which the owls depend for nesting burrows, have been identified as the primary factors contributing to the disappearance of Burrowing Owls from British Columbia (Dunbar 1983). Specimen collection for museums (Campbell, pers. comm.) and burrow collapse caused by cattle (R. Lincoln, pers. comm.) may also have contributed to population decline.

By 1980, Burrowing Owls were considered to be nearly extinct as a breeding species in British Columbia and were designated as endangered. A preliminary recovery plan (Dunbar 1983) recommended placement of artificial burrows and reintroductions of owls to re-establish a breeding population.

From 1983 to 1988, excluding 1986, the B.C. Ministry of Environment participated in a cooperative program with the Washington State Department of Wildlife to reintroduce Burrowing Owls to British Columbia. Owls were captured in the Moses Lake area of Washington and transplanted to the South Okanagan Valley (Fig. 1). It was hoped that the hatchlings would imprint on the release site and return to breed in future years, thus establishing a self-sustaining breeding population. This report describes the methods used to transplant owls and summarizes the accomplishments of the program to date.

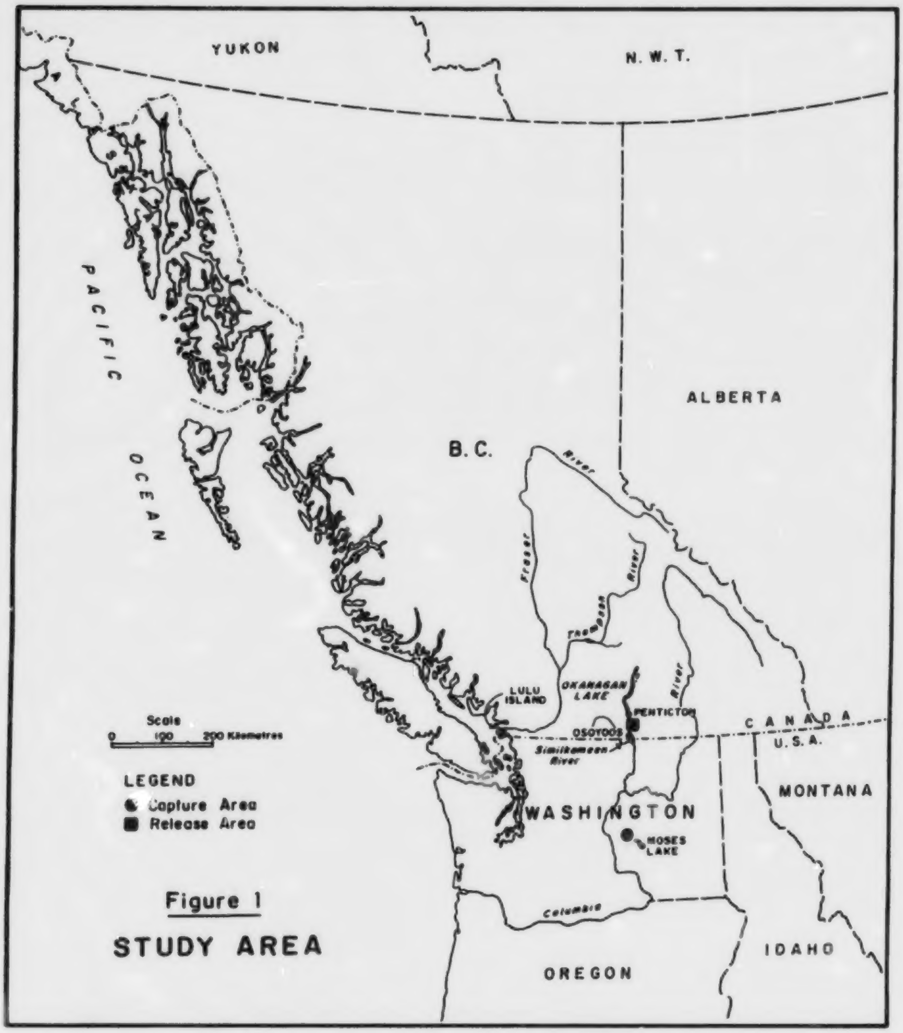
METHODS

Site Preparation

Release sites were chosen primarily for their habitat quality, open grasslands with sandy or loamy soils, and secure land tenure. Due to a lack of suitable nesting burrows and logistical problems with transplanting very young hatchlings to natural burrows, artificial burrows were constructed and placed at the release site prior to transplanting the owls.

Artificial wooden burrows, modified from Collins and Landry (1977), were used from 1983 to 1985. Untreated, 1 1/2 inch (3.8 cm) thick lumber was used for construction. Each burrow consisted of an L-shaped tunnel, a one 6-foot (1.8 m) long section attached at a right angles to a 3-foot (0.9 m) section, which led underground to a 12 inch (30 cm) square, covered nest box. The wooden burrows were gradually destroyed by termites and fungal attack making them useless after 2 or 3 years.

In 1985, plastic tunnels were tested and from 1986 to 1988 plastic artificial burrows were used. Each burrow consisted of a 9-foot (2.7 m) length of 6-inch (15 cm) diameter, perforated Big-"O" drainage pipe attached to a 12-inch (30 cm) diameter inverted plastic bucket, which acted as the nest chamber. The pipe was bent into a U- or J-shape and placed in a trench so the top of the nest chamber was about 18 inches (46 cm) below the soil surface. A hole was cut in the top of the nest chamber, to allow easy access. The chamber was covered with an inverted "Melmac" plate lid and the burrow was covered with soil.


YUKON
N. W. T.
PACIFIC OCEAN
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B.C.
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LULU ISLAND
OKANAGAN LAKE
PENTICTON
OSOYOOS
Similkameen River
C A N A D A
U. S. A.
MONTANA
WASHINGTON
MOSES LAKE
Columbia
OREGON
IDAHO
Scale
0 100 200 Kilometres
LEGEND
● Capture Area
■ Release Area
Figure 1
STUDY AREA

Figure 1. Study area for the Burrowing Owl capture and release program.

Temporary flight pens were constructed to ensure that the transplanted adults could not abandon the hatchlings. Each pen was designed to hold one family of owls and was built over two artificial burrows. The pens were rectangular, approximately 17-feet (5.2 m) long, 8-feet (2.4 m) wide, and 6-feet (1.8 m) high. From 1983 to 1987, the pens were made of 1/2 inch mesh seine net, laid over a two by four and post frame. In 1988, the pens were made from plastic "Birdnet" (Conwed Corporation 1980) and suspended from four corner posts; this material has caused injury to some of the birds and its use is being reevaluated.

Capture, Transport, Release, and Monitoring

Active Burrowing Owl burrows were identified near Moses Lake, Washington where the owls are common nesters. To minimize potential impacts on the Washington population, only owls at sites where hatchling mortality was likely to be high were selected for transplanting. Sites with high mortality included road edges, construction sites, tilled agricultural fields, and rifle ranges.

A 7 x 7 x 24 inch (18 x 18 x 61 cm), two-door, live trap (Havahart) was used to capture adult owls. The trap was set in the entrance of an active burrow and camouflaged with burlap, soil and local vegetation (modified from Ferguson and Jorgensen (1981)). Traps were set in the evening and checked at 2 or 3 hour intervals through the night. When one adult was caught, it was placed in a perforated cardboard transport box and the trap was reset. When only one owl was caught by noon the following day, trapping at that burrow was generally abandoned and the captured bird was released. However, on two occasions, a single adult was transplanted with its brood when its mate could not be captured. At sites where both adults were captured, the burrow was carefully excavated with a shovel to retrieve the young. The hatchlings were placed in a transport box and taken, along with the adults, to a local veterinarian.

All birds were dusted for fleas with "Mycodex" powder and inspected for disease by a veterinarian. Human fleas, *Pulex iritans*, were identified on the owls; these have also been found on badgers (Sydney Cannings, pers. comm.). The owls were fed chicken liver and banded with Canadian Wildlife Service aluminum lock-on bands. A poultry export permit and a C.I.T.E.S. (Convention on International Trade of Endangered Species) permit were completed after the inspection to allow export of the birds from the United States.

The owls were transported to the border by aircraft in 1983 and 1984 and by vehicle from 1985 to 1988. At the border, the birds were inspected by an American and a Canadian Federal Veterinarian and by Customs Inspectors from both countries. After completing the necessary paperwork, the birds were transported to the release site, arriving about 24 hours after trapping began.

At the release site, the hatchlings were fed again and placed in an artificial nest chamber in a flight pen. The adults were released down the tunnel of the burrow and a supply of dead, day-old cockerels was left in the flight pen as a food source. The release was done quickly and researchers left immediately to minimize stress on the birds. After 2 weeks, the owls had adjusted to the release site and the pens were removed.

The owls were fed daily until the young were fledged and then the artificial food supply was gradually decreased. The birds were monitored daily until late August and then irregularly until after the last birds had left the site, as late as November in some years.

Study Area

The release sites are located in the Southern Okanagan River Valley in south-central British Columbia (Fig. 1). The Vaseux site, used in 1983 and 1984, is located on the west side of Vaseux Lake approximately 30 km north of the U.S. border. The Osoyoos site, used from 1985 to 1988, is located northeast of Osoyoos Lake, approximately 10 km north of the border.

Both sites are within the Bunchgrass Biogeoclimatic Zone (Erickson 1985). Vegetation consists mainly of grasses; Cheatgrass (*Bromus tectorum*) and Bluebunch Wheatgrass (*Agropyron spicatum*) are most abundant. A variety of forbs, Prickly-pear Cactus (*Opuntia fragilis*) and scattered shrubs, mainly Antelope-brush (*Purshia tridentata*), are also found at both sites.

RESULTS

A total of 24 families of Burrowing Owls, including 46 adults and 211 hatchlings, was transplanted to the South Okanagan Valley between 1983 and 1988 (Table 1).

The last breeding record for the Osoyoos area, prior to this program, was 1950 (Howie, pers. comm.). Although no birds returned to the release site in 1984 or 1985, breeding has been continuous since then. Twenty-seven occurrence records for adult Burrowing Owls were reported between 1986 and 1989, including 20 breeding bird records (10 pairs) and seven records of single birds. All of these birds returned to the site after at least one winter migration. In addition, returning owls fledged 25 young, bringing the total occurrence records to 52. Band numbers were confirmed for 17 of the 27 occurrence records; these related to 13 individual birds. Of these 13 owls, 11 were transplanted as hatchlings and two were transplanted as adults. Three of the hatchlings and one of the adults were recorded twice in the occurrence records, one record in each of two years. Seven occurrence records were for banded birds where the band numbers could not be confirmed. Two records were for unbanded owls and one was for an incomplete carcass where the presence or absence of a band could not be determined.

Table 1. Summary of information related to the South Okanagan Burrowing Owl reintroduction program (1983 to 1988).

	TRANSPLANTED OWLS			OWLS RETURNING TO OSOYOOS	
YEAR	ADULTS	HATCHLINGS	# FLEDGED	ADULTS	# FLEDGED
1983	2	9	6	0	0
1984	5	24	19	0	0
1985	10	41	38	0	0
1986	0	0	0	4	2
1987	9	41	26	2	4
1988	20	96	68	6	6
1989	-	-	-	15*	13
Total	46	211	157	27	25

*Eight birds paired, seven others did not form pairs.

DISCUSSION

The methods used in this program to reintroduce owls were successful in reestablishing breeding birds at the Osoyoos release site. We cannot predict at this time whether a self-sustaining population can be established using these methods. More data must be collected from additional transplants to determine whether this goal is possible.

Accurate interpretation of the data related to returning birds is not possible at this time because the origin of 10 (37%) of the 27 occurrence records for returning birds could not be confirmed. In addition, it is likely that the lack of intense early spring monitoring at the release sites and adjacent areas resulted in incomplete occurrence records. Fledging rates for returning birds are also biased due to the high percentage of first-year breeders in the sample; these birds are known to have poorer nesting success than older birds. It is clear, however, that a minimum of one hundred hatchlings must be transplanted yearly for a period of several years before a substantial breeding population can be established.

CONCLUSION

A breeding population of Burrowing Owls was established in southern British Columbia as a direct result of transplanting owls from Washington State. The goal of this program was to reestablish a "self-sustaining" breeding population. Transplants are scheduled to occur yearly until 1993. The additional data from those transplants will help to determine if this goal is attainable.

ACKNOWLEDGMENTS

I would like to express my sincere thanks to the following people and organizations for their contributions to the reintroduction program. This program could not have been undertaken without assistance and support from the Washington State Department of Wildlife, in particular Ron Friesz who coordinated the capture phase. Bob Lincoln and Alan Peatt from the British Columbia Ministry of Environment contributed substantially in all aspects of this program since its inception. Debbi Hlady, Jeff and Sue Turner, Jeff Morgan, Maria Leung, Don and Angelika Harvey, Andrew and Cheryl Bryant, Marcia and Bill Radke, and Melissa Graff all worked long hours, beyond the call of duty, to ensure the reintroductions were successful. Big-"O" Incorporated donated pipe for burrow construction. Leigh Dyer, Mike Sarell, and Anthea Bryan provided editorial comments on the draft of this report and Ken Ballantyne drafted the study area map. Special recognition must be given to the B.C. Habitat Conservation Fund for providing support and all major funding for this program.

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OPERATION BURROWING OWL

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Operation Burrowing Owl was initiated in 1987 by Saskatchewan Parks, Recreation and Culture, Saskatchewan Natural History Society, Saskatchewan Wildlife Federation, World Wildlife Fund Canada, and Wildlife Habitat Canada as a primary step in the conservation and management of the Burrowing Owl (*Athene cunicularia*) in Saskatchewan. On June 4, 1987, His Royal Highness, Prince Philip officially initiated Operation Burrowing Owl at Grant and Sheila Fahlman's farm near Kronau, Saskatchewan. The extensive press coverage of this event increased public awareness about the Burrowing Owl and its status in Saskatchewan.

The main objectives of Operation Burrowing Owl were (1) to survey Burrowing Owl populations across Saskatchewan and estimate regional and provincial populations, (2) to initiate a habitat retention program for Burrowing Owl nesting areas (Goals were to protect 300 sites in 1987 and another 200 sites in 1988.), (3) to place nest boxes in suitable breeding areas to facilitate research as well as enhance nesting areas, (4) to establish a method for an annual census of the Burrowing Owl on protected habitats and for reinforcing the importance of Burrowing Owls to the landowner, (5) to increase public awareness that the Burrowing Owl is a threatened species, and (6) to collect data on habitat selection and use by the Burrowing Owl.

The initial step of the project was to obtain locations of Burrowing Owl nesting sites. In the spring of 1987, a mailout questionaire was sent to all rural addresses in the entire southern portion of the province, north to Saskatoon. The returned questionaires were the main source of Burrowing Owl sightings. Other sightings were reported by phone or personal letter. Field work began in the summer of 1987. Staff members Wendy Lyon, John Pollack, and Craig Palmer conducted the main survey between May 15 and September 29, 1987 and May 1 and July 31, 1988.

Each reported site was visited to see if Burrowing Owls were present and to see if they were on suitable breeding habitat. If owls were on good habitat, the landowners were contacted to see if they were interested in Operation Burrowing Owl. The program offered two types of agreements, voluntary and contractual. Under the voluntary agreement, the landowner agreed to keep nesting areas in their present condition. The contractual agreement was offered to those landowners who had five or more nesting pairs of Burrowing Owls on their land. Those who had five to nine pairs would receive $100 annually while those who had more than nine pairs would be paid $200 annually. Contractual agreements required that the habitat remain unaltered and that pesticides, herbicides, or rodenticides not be used on or around the nesting area without prior approval of Saskatchewan Parks, Recreation and Culture. Few contractual agreements were signed because landowners could not accept the restriction on the use of chemicals, some landowners did not want the money and there was a small number of large colonies. Landowners also agreed to report the number of Burrowing Owls on their land each year. Landowners that enrolled in either program received a personalized gate sign and are sent an annual newsletter.

The possibility of placing nest boxes was also examined when the survey was being carried out. Plans for the nest boxes and instructions on proper placement were given to landowners. Staff members also placed nest boxes in areas around Regina. By the end of 1988, 96 boxes had been placed in 25 different sites in the study area; these are only the boxes known to the project.

All data were placed in a computer file at the Wildlife Branch in Regina. All voluntary agreements were sent to the Saskatchewan Wildlife Federation in Moose Jaw.

The provincial population of Burrowing Owls was estimated to be 1500 pairs in 1988. This estimate was based on (1) the total number of pairs found in 1988 (N = 941), (2) an estimated 192 pairs of Burrowing Owls on sites visited in 1987 but not visited in 1988 (These were sites not signed into the program), (3) an estimated 80 pairs on unsurveyed sites reported to us after July 31, 1988, (4) an estimate of at least 200 pairs on unreported sites, and (5) an estimated 150 pairs, the number estimated by Wedgewood (1978), on P.F.R.A. and community pastures, which were not part of our survey.

Operation Burrowing Owl had 336 landowners in the program at the end of 1988. There were 394 protected sites supporting 742 nesting pairs of Burrowing Owls on 25,261 acres (10,205 ha). Gate signs plus annual contact with the landowners will hopefully maintain public awareness of Burrowing Owls.

Operation Burrowing Owl has successfully raised public awareness of the Burrowing Owl. Not only is habitat being set aside but an annual census of owls can be obtained. Hopefully, the cooperation of landowners will be as good in the future as it has been in the last 2 years and efforts for the Burrowing Owl will be ongoing.

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1988 MANITOBA BURROWING OWL CONSERVATION PROGRAM: STATUS REPORT

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INTRODUCTION

In 1978, the Committee on the Status of Endangered Wildlife in Canada listed the Burrowing Owl (*Athene cunicularia*) as "threatened" in Canada. The total number of Burrowing Owls in Canada was estimated to be 2000 pairs with 110 pairs believed nesting in Manitoba at that time (Wedgewood 1978).

From 1982 to 1984, Ratcliff (1986) developed and implemented formal surveys to assess current status and distribution of Burrowing Owls in Manitoba. Over the 3-year period, he documented a decline from 76 nesting pairs in 1982 to 35 nesting pairs in 1984. This decline was concurrent with a range contraction of approximately 200 km toward the southwestern corner of the province. During 1985, 1986, and 1987, a continued decline in nesting pairs was observed.

In 1987, the Manitoba Department of Natural Resources in cooperation with World Wildlife Fund Canada and Habitat Heritage Manitoba initiated a Burrowing Owl Conservation Plan for Manitoba. An active management plan was developed which included surveys to monitor population levels, landowner contacts and public education, habitat protection in the form of long-term lease agreements, installation of artificial burrows, and owl banding and color-marking. With the cooperation of the province of Saskatchewan and British Columbia, a pilot Burrowing Owl Reintroduction Program was initiated at Oak Hammock Marsh Wildlife Management Area (OHMWMA).

In 1988, the Burrowing Owl Conservation Plan continued with three major components: (1) an education program directed toward the farming community and the general public, (2) assessment of the number of owls in the province through a survey of historical nest sites and adjacent areas, and (3) an expansion of the reintroduction program in Manitoba. Owls were released at OHMWMA for the second year and at a new release site near Lyleton, Manitoba.

METHODS

Education Program

Posters describing the rapid population decline of the Burrowing Owl and the danger of carbofuran insecticides (James and Fox 1987) were distributed to landowners, post offices, general stores, and Rural Municipality Offices in southern Manitoba.

Population Surveys

Historic nest sites which appeared to provide suitable nesting habitat (Zarn 1974) were checked for nesting owls an average of once every 3 weeks from 5 May to 28 June. Checking was done with binoculars and a spotting scope and by broadcasting tape-recorded territorial calls with a cassette tape player, amplifier, and public address loud speaker (Martin 1973, Haug unpublished data). At all active sites, owls were monitored a minimum of once every 2 weeks from 5 May to 16 August.

Attempts were made to trap, band, and color-mark all young Burrowing Owls on the study area. Net traps with one-way doors were used in the nest burrows to capture young owls. Adult owls were trapped with padded steel leg-hold traps (#0) buried at the entrance to the nest burrows and on the perimeter of the net traps. Owls were banded with U.S. Fish and Wildlife Service aluminum leg bands and color-marked with black plastic jesses (Haug 1985).

Owl Transplant Program

Lyleton Release

Five holding pens were designed and built in Winnipeg and assembled on site. All pens were made of sections 1.25 m (4 ft) wide x 2.45 m (8 ft) tall, constructed of wood frames covered with 5 cm (2 in) black plastic mesh or 2.5 cm (1 in) green cloth netting. The sections were bolted together to facilitate assembly and disassembly. The dimensions of four pens were 2.45 m x 2.45 m (8 ft x 8 ft) and the fifth pen was 2.45 m x 3.65 m (8 ft x 12 ft). The roofs were pieces of netting with "bungy-cord" woven along all four edges which fit snugly over the top of the pens. Artificial burrows with nest chambers and perching poles were placed in each pen. The pens were assembled 20 to 25 m apart in a loose group with an electric fence encircling the group to restrict access by cattle.

Five family groups of owls were captured and transported from the area of Regina, Saskatchewan on 25-26 June. Adults were captured using padded steel leg-hold traps (#0) buried at the burrow entrances. Attempts were made to catch both adults and then the nest chambers were excavated and the young owls were caught by hand. All owls were fed, banded and color-marked, and placed in the artificial burrows in the release pens within 24 hours of capture. Owls were fed a diet of laboratory mice and day-old chicks.

All pens were disassembled and the owls released on 16 July. Pellets were periodically checked to determine the diet of the owls and their ability to feed themselves. On 17 August, after one week of finding evidence of insects in pellets, feedings were discontinued.

Oak Hammock Marsh Release

For the second consecutive year, a privately-owned pasture north of OHMWMA (Hiltz 1987) was used for the reintroduction program. One 3 m x 6 m pen was erected over three artificial burrows by OHMWMA staff. Ten captive-reared Burrowing Owls (approximately 3 months old) were received from the Owl Rehabilitation Research Foundation (ORRF) on 21 July and were released on 26 July. All owls were banded with U.S. Fish and Wildlife Service aluminum bands at ORRF and color-marked before being placed in the pen.

RESULTS AND DISCUSSION

Population Surveys

A total of 129 Manitoba historical (1982-1987) nest sites and surrounding pastures were checked and 28 nesting pairs and six single owls were located. Of these 28 nesting pairs, 19 pairs (68%) successfully raised at least one young owl to fledging. The average brood size was 5.5 young per successful pair or 3.8 young per known nesting pair.

A minimum of 105 young were counted of which 72 were trapped, banded, and color-marked with a single black jess on the right leg. Four adults were trapped, banded, and color-marked with a black jess on the left leg. Two previously banded adults were also trapped and their band numbers were recorded. Including the owls transported from Saskatchewan and released at Lyleton, 105 owls were banded and color-marked.

Habitat Loss

Of the 129 historic nest sites known to have been active during the period from 1982 to 1987, a minimum of 26 were lost to cultivation or urban development. This represents a 20% loss of Burrowing Owl nesting habitat over this 6-year period.

Owl Transplant Program

Lyleton Transplant and Release

A total of seven adults and 22 young owls were trapped from the Regina area and transplanted to the Lyleton area. The owls were were released on 16 July. Within a few hours of release, both adults and young owls were flying short distances to nearby natural burrows and exploring the immediate area. During the 5-week release period, both young and adult owls were observed flying short distances, hunting for insects and feeding from the hack boards. It was not known how many adults remained at the site after release but some adults were observed feeding young of different ages. A maximum of 20 owls were observed simultaneously on 21 July.

Behavioral observations suggested the owls were aware of natural predators and they were heard giving alarm calls as large hawks flew nearby. A Prairie Falcon (*Falco mexicanus*) was observed to chase six young owls into an artificial burrow.

Oak Hammock Marsh Release

On 21 July 1988, ten captive-reared Burrowing Owls were received from the Owl Rehabilitation Research Foundation. On 26 July, the pen was disassembled and the owls were released. These owls remained in the area for less than 48 hours and then dispersed. The remains of three young owls were found in the release area and mortality was attributed to avian predation.

FUTURE PLANS

The future of the Burrowing Owl conservation program in Manitoba is dependent on funds from both government and private sources. It is currently anticipated that this program will be continued until 1992, at which point it will be reviewed and assessed. The banding and color-marking program will be expanded in cooperation with other prairie provinces to aid in determining wintering areas and annual mortality. Public education must be stressed to help find new nest sites and encourage private landowners to maintain the current habitat in its present natural state.

ACKNOWLEDGEMENTS

Financial support was provided by World Wildlife Fund Canada and Manitoba Natural Resources. Administrative support was provided by the Manitoba Naturalists Society. I gratefully acknowledge participation from Carol Churchward, Merlin Shoesmith, Bob Nero, Andrew Didiuk, Garth Ball, Murray Gillespie, Ken De Smet, Mike Conrad, Bill Koonz, Ted Muir, David Plews, Brian Ratcliff, Mark Glenwright, Cal Cuthbert, John Murray, Gerry Greenley, Tim and Michelle McMechan, Kay and Larry McKeever, Brian Ratcliff, and the staff and volunteers of OHMWMA.

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THE LOGGERHEAD SHRIKE IN ALBERTA

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In 1988, Loggerhead Shrikes (*Lanius ludovicianus*) were surveyed in two areas of Alberta. The primary study area was approximately 1200 square miles (3100 km^2) and located in the general area of the lower Red Deer and South Saskatchewan Rivers. Survey dates were June 10 to 15 inclusive. The secondary study area was approximately 1500 square miles (3880 km^2) in the general area of Manyberries-Wildhorse and including the Milk River. Survey dates were June 18 to 22 inclusive and June 28. During the summer of 1988, shrikes were observed in other areas of southern Alberta incidental to other field work. For purposes of this discussion, the two study areas will be referred to as the Red Deer River and Milk River study areas.

RED DEER RIVER STUDY AREA

Shrikes were observed at 104 sites. These sites were divided into 55 nest sites and 49 non-nest sites. Non-nest sites were locations where one or two adult shrikes were observed but a nest was not located. From field experience, it was felt that these non-nest sites in fact represented a nesting pair of shrikes. There were 55 sites (53%) in natural habitats and 49 sites (47%) in cultivated areas.

The Red Deer River study area can be loosely divided into six habitats: (1) Thorny Buffaloberry (*Sheperdia argentea*) bushes along the railroad tracks that parallel Highway 555, (2) exotic shelter belts and hedgerows, (3) the Red Deer River Valley, (4) rolling sandhills areas, (5) the South Saskatchewan River valley, and (6) scattered upland sites. The areas of the railroad tracks and exotic hedgerows accounted for 73.1% of the sites found. With only a few exceptions, shrikes were present in every Thorny Buffaloberry patch or shelter belt and hedgerow in the area.

Shrike nests were found at all stages of the nesting cycle from nest-building to young near fledging. Six or seven eggs represented the usual clutch size. Nests were usually made of twigs of the same shrub that the nest was placed in. The nest lining was usually made of grasses with either a few feathers or some cow hair woven into the structure. In several instances, a roof was loosely built over the nest. Over 50% of the nests were 3 to 4 ft (90-120 cm) above ground. Nests were usually built in small clumps of shrubs. When the nest was built in a large shrub patch, it was placed near the edge of the patch. It appears that shrikes prefer smaller patches of shrubs that are somewhat isolated from other shrub patches and an expanse of open country around the nest patch. Areas of continuous vegetation had few or no shrikes. Two unusual nests were built directly on top of piles of Russian-thistle (*Salsola pestifer*). Old nests persist from previous years but are quite easy to distinguish from new nests. As many as 10 old nests were found near new nests. In most cases, shrikes were not aggressive around their nests.

MILK RIVER STUDY AREA

Shrikes were observed at 28 sites. These sites were divided into 15 nest sites and 13 non-nest sites, however, it was felt that non-nest sites did in fact represent a nesting pair of shrikes. There were 16 sites (57%) in natural habitats and 12 sites (43%) in cultivated areas.

The Milk River study area can be loosely divided into three habitats: (1) natural shrub communities in valleys including the Milk River, (2) exotic shelter belts and hedgerows, and (3) miscellaneous upland sites. The first two areas accounted for 78% of the sites found.

Shrike nests were found at all stages of the nesting cycle from nest-building to fledged young. Six or seven eggs represented the usual clutch size. Nests were usually made of twigs of the same shrub that the nest was placed in. The nest was usually made of grasses with cow hair woven in. Only in a very few cases were feathers woven into the lining. An unusual nest was located in a solitary sagebrush shrub with a branch forming a roof over the nest. As in the Red Deer River study area, adult shrikes were not aggressive.

OTHER AREAS

Shrikes were observed in four other areas of Alberta in 1988 during other field research. There were a few shrikes observed in the Etzikom, Medicine Hat, Lethbridge, and Sullivan Lake areas. The Sullivan Lake area was unusual because there were five sites in a small area near the northeast corner of the lake. Despite intensive field work in southern Alberta, I did not observe other shrikes.

DISCUSSION

Loggerhead Shrikes have drastically declined over many parts of Alberta in the last 50 years. Shrikes were a "common summer resident" in the Camrose area (Farley 1932) and were frequently observed 40 years ago in the Buffalo Lake area (G. Trout, pers. comm.). In 1988, I observed no shrikes in these areas despite fairly intensive field work. Shrikes may in fact occur north to the cleared portions of the Boreal Forest region. Historic populations in the Aspen Parkland have virtually disappeared.

Although current popular literature (e.g., Salt and Salt (1976)) claims that this species is fairly common to common over southern and eastern Alberta, shrikes appear to be almost nonexistent except in two areas. These include a major population in the Red Deer River study area and a smaller population in the Milk River study area.

In the two study areas, shrikes appear to have adapted to the exotic plantings of shelter belts and hedgerows. Their numbers may now be greater in these areas than in historic sites. Despite this apparent adaptation, shrikes do not appear to have adapted to exotics in other areas of Alberta.

RECOMMENDATIONS

(1) More field work is required in both study areas to adequately survey parts of these areas that were not adequately surveyed in 1988.

(2) Natural habitats must be protected because they function as reservoirs and because of the potential for failure in disturbed habitats. This is exemplified by the precarious position of the narrow strip of habitat between the railroad tracks and Highway 555 in the Red Deer River study area; railroad alterations or road widening could wipe out an area which supports a significant number of shrikes. Habitat protection would help shrikes but would also help other species.

(3) Especially in the Red Deer River study area, thought should be given to planting Thorny Buffaloberry in disturbed areas. Thorny buffalo berry is native to the area and is a preferred nesting shrub. Planting would be relatively easy and inexpensive. Plantings would function like Bluebird trails and provide nesting habitat. The more shrikes there are, the less precarious their population status.

(4) Banding of shrikes could be easily intensified in the study areas. Any additional information that is gained on a threatened species can only be of value in managing the species.

(5) Land use practices in the study areas should be examined. Pesticide use, for example, may have a significant impact on species such as shrikes.

(6) All landowners in both study areas should be contacted so that a more complete census of shrikes can be carried out, including the gathering of historic data, to get input from landowners on potential plans for increasing shrike numbers and to convince landowners of the uniqueness of their having shrikes on their property. Landowners could be given brief information packages and this could result in active protection by people who live with the shrikes.

CONCLUSION

It seems a truism that any study of a particular species always results in a plea for more study. However, in the case of the Loggerhead Shrike in Alberta, it does seem very appropriate that a more complete study be conducted in 1989. With a more complete study instead of brief surveys, a comprehensive management plan could be in place by the spring of 1990. Otherwise, any environmental change could go undetected.

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STATUS AND HABITAT NEEDS OF THE LOGGERHEAD SHRIKE IN MANITOBA

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INTRODUCTION

This talk addresses field work carried out in Manitoba during 1987 and 1988 as part of a prairie-wide effort to assess the status, distribution, and nesting requirements of Loggerhead Shrikes (*Lanius ludovicianus*). This work was funded by the Manitoba Naturalists Society and the Natural Resources Institute, University of Manitoba.

METHODS

To select study areas for work on Loggerhead Shrikes and other threatened and endangered grassland species, computerized data on the distribution of grasslands in Manitoba were examined. Townships with abundant grasslands (pasture, haylands, and prairie) were identified. Forest inventory maps were obtained for these townships and the maps were used in planning routes and as field sheets. When a shrike was found, it was usually observed for 5 to 15 minutes. Site information, weather data, and shrike behaviour (perching sites, movements) were recorded on prepared data sheets.

Nest searches were conducted if the shrike's behaviour suggested nesting in a site that could be readily located. In 1988, additional effort went into finding nests, especially in areas dominated by field hedgerows or willow-lined lowlands in cropland. Nests were revisited at irregular intervals to assess nesting success and to band young. In 1987, 92 young were banded with aluminum bands and 350 young and two adults were banded with aluminum and red plastic bands in 1988. It is hoped that the use of colour bands will increase reporting rates on the wintering grounds and will assist in finding returning shrikes.

DISTRIBUTION AND STATUS

In 1987, the Canadian Wildlife Service set up survey routes across the prairie provinces to assess nesting densities. In Manitoba, these routes covered over 2000 km within much of the present range of the Loggerhead Shrike. Shrikes were only encountered on three of the 11 routes and 21 of 24 shrikes observed were on one route in the extreme southwest. The distribution of 268 sightings of suspected nesting pairs in 1987 also reveals the importance of the extreme southwest; an area encompassing 0.5% of the total area of Manitoba supported 85% of the shrikes observed during 1987. Fewer shrikes were observed in 1988 in spite of more intensive field efforts within the main range of the Loggerhead Shrike; the total of 232 suspected pairs was 33 fewer than in 1987. In the main part of their range, numbers remained constant even though coverage effort was doubled in 1988. Hence, we concurred with several other observers in the southwest who felt that numbers had declined. One observer near Reston who provided detailed records during both years felt that the decline in that area was about 50%. Numbers of territorial shrikes were also down near Winnipeg, where the more endangered *L. l. migrans* subspecies is believed to occur. (The *L. l. excubitorides* subspecies is the more common subspecies.)

NESTING ECOLOGY AND PRODUCTIVITY

Clutch initiation during both years commenced in mid-May and ended in early July. Average clutch size, in 57 clutches that were believed to be complete, was 6.0 eggs. Of 63 nests found with eggs and monitored until fledging, 33 (52%) were successful. An average of 5.0 young per successful nest or 2.6 young/nest were fledged. Actual fledging success was undoubtedly lower since some nests would have failed prior to being found and others would have failed or lost young between banding and fledging.

Three-quarters of the 102 nests found in 1988 were in willow shrubs (including six in old magpie nests), eight were in Siberian elm (*Ulmus pumila*) hedgerows, seven in green ash (*Fraxinus pennsylvanica*), four in Manitoba maple (*Acer negundo*), three in caragana (*Caragana arborescens*) hedges, one in a cottonwood (*Populus* sp.), one in bulldozed brush, and one in a wire roll. It is worth noting that none were in aspen (*Populus tremuloides*), a widespread tree in the area (one of 67 nests in 1987 was in an aspen) and none were in hawthorn (*Crataegus* sp.), the predominant shrub used by the *migrans* subspecies in eastern North America. (A nest believed to have been used in 1988 was found in a hawthorn just outside Winnipeg.)

Habitat use and productivity during 1988 was compared in three widely divergent habitats in the extreme southwest where shrike populations are relatively healthy: (1) the typical extensive grassland habitat (mostly pasture) found in townships 3-28 and 4-28, (2) habitat dominated by hedgerows and cropland in townships 1-28 and 2-28, and (3) habitat dominated by willow-lined lowlands in cropland found in townships 4-29 and 5-29. In the hedgerow/cropland townships, 18 of 22 nests were in cultivated fields (Table 1). Nineteen of 22 nests in this area were in hedgerows compared to none in the other two habitats. Productivity was the lowest in this habitat as only two of seven nests found at the egg stage were successful, producing 11 young (1.6 young/nest). In willow-lined lowland/cropland townships, 10 of 14 nests were in cropland (mostly in dense willows surrounding temporary wetlands). Although three of five nests in these townships were successful, only nine young (1.8 young/nest) were produced. In the extensive grassland townships, 14 of 28 nests were in pastureland (mostly in grazed, open willows). Nine of 13 nests found at the egg stage in this area were successful, producing an average of 3.7 young/nest.

Predation was believed to be the main reason why productivity in hedgerow and willow-lined lowland townships was less than half of that in the grassland-dominated townships. Shrikes nesting in hedgerows or lowlands in crops not only had many more potential avian predators nesting in association with them but usually had to travel greater distances to obtain food. In cropland, these shrike nests frequently failed during the laying or brood-rearing stages. Brewer's Blackbirds (*Euphagus cyanocephalus*) often nested in the same lowlands as Loggerhead Shrikes. In hedgerows, Loggerhead Shrikes nested with a multitude of potential avian predators including American Crows (*Corvus brachyrhynchus*), Black-billed Magpies (*Pica pica*), Blue Jays (*Cyanocitta cristata*), and numerous others.

A major problem faced by shrikes nesting in townships dominated by croplands was that optimal hunting was in distant pastures or roadsides. Partial or complete nest losses may have occurred while the adults were foraging for food for the developing young. Collisions with vehicles probably also accounted for a higher percentage of shrike mortality in these areas. Mortality from crop or roadside spraying, including the use of Furadan for grasshopper control, would also be expected to be greater in these areas. In contrast, shrikes nesting in open, grazed willows in extensive pastures usually had few species nesting in association with them, had plenty of food nearby for the developing young and did not have to rely on roadsides to the extent that shrikes in the other two areas did.

Table 1. Comparison of habitat preferences, nest site selection, and nesting success among Loggerhead Shrikes in hedgerow/field townships (1-28 and 2-28), willow-lined lowland/field dominated townships (4-29 & 5-29) and extensive grassland-dominated townships (3-28 and 4-28) during 1988.

	Number of Nests by Surrounding Habitat:			Number of Nests by Nest-Site Habitat:				Nesting Success		
Townships	Cropland	Hayland/Idle	Pasture	Hedge	Dense Willows	Open Willows	Other	No. Nests Successful	No. Young Fledged	Young/ Fledged Nest
1-28 and 2-28 (hedgerow/ field)	18	3	1	19	2	0	1	2 of 7	11	1.6
4-29 and 5-29 (lowland/field)	10	2	2	0	10	4	0	3 of 5	9	1.8
3-28 and 4-28 (extensive grasslands)	6	8	14	0	9	18	1	9 of 13	48	3.7

MANAGEMENT IMPLICATIONS

Given the limited distribution of shrikes in Manitoba and their relative scarcity in all except the extreme southwest, their "threatened" status in the province should be upheld. Populations of the *migrans* subspecies in southeastern Manitoba warrant special attention. In the southwest, the extensive pastureland extending from Pierson to Broomhill (locally referred to as "the Poverty Plains") forms the nucleus of breeding habitat for Loggerhead Shrikes in the province. This area merits special consideration for protection. Away from these extensive grasslands, shrikes appear to be in suboptimal habitat in the hedgerow-dominated townships to the south near Lyleton, the willow-lined lowland/cropland-dominated townships to the west (4-29 and 5-29), and to the north (Shrikes are locally abundant to the north to Reston and beyond).

Although productivity in Manitoba appeared adequate, more information on survival of the young after fledging is required. Most shrike families remained near the nest site for at least a month after fledging, but usually only a portion of the family was encountered. Even extended observations failed to turn up all the young. Whether the remaining young had perished or were some distance from the nest was not ascertained. Perhaps a portion was with each adult. During 1988, several road-killed immatures were found; some residents describe road-killed shrikes as commonplace during some years. Hence, road-kills and other post-fledging losses may have a bigger impact on productivity than we realize. Telemetry may be necessary to fully appreciate the impact and magnitude of these losses.

SWIFT FOX REINTRODUCTION INTO CANADA

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ABSTRACT

Swift Fox (*Vulpes velox*) were once abundant on the Canadian prairie but the last generally accepted sighting occurred in 1938. An attempt to reintroduce Swift Fox into the prairie region of Canada began in 1976. Since then 207 Swift Foxes have been released in Alberta and near the Alberta-Saskatchewan border. An additional 60 Swift Foxes were released in Saskatchewan. Both hard- and soft-release methods have resulted in most foxes remaining near their release area when conditions were favorable. The mean number of days that foxes were known to have been alive (determined primarily by telemetry) was 273; 37 Swift Foxes are known to have survived 200 days or more. During spring of 1988, a minimum of seven free-ranging pairs produced at least 31 pups. A minimum of 22 out of 35 (63%) of Swift Foxes found dead were killed by predators, primarily Coyotes (*Canis latrans*). The drought of 1988 appeared to have been a cause of very early family break-up, dispersal, and considerable mortality. We do not consider Swift Foxes to yet be re-established in Canada. Steps are presented to achieve this goal.

INTRODUCTION

Swift Foxes (*Vulpes velox*) were once abundant on portions of the North American prairie. In Canada, their range extended from the Pembina Hills in Manitoba across southern Saskatchewan to the southern foothills of the Rocky Mountains. This distribution corresponded closely with the extent of the mid-grass prairie ecoregion of Canada.

An indication of the former abundance of Swift Foxes is given by records of the Hudson's Bay Company, which show that between 1853 and 1877, an average of 4876 pelts were sold annually (MacFarlane 1905, as cited in Rand 1948). By 1900, the Swift Fox was all but gone from the northern extent of its range (Hillman and Sharps 1978). In Canada, the last recorded specimen was taken in 1928 near Govenlock, Saskatchewan, while the last generally accepted Canadian sighting was made near Manyberries, Alberta in 1938 (Soper 1964).

The demise of the Swift Fox in Canada began with the extirpation of free-ranging herds of Bison (*Bison bison*) and the collapse of the prairie ecosystem as it had evolved and existed for some 10,000 years. Poisoning, trapping, shooting, and massive changes regarding food, competitors, and habitat played reinforcing roles.

Between 1922 and 1925, an average of only 508 Swift Fox pelts were taken per year on the Canadian prairie (Statistics Canada Cat.#23207, as cited in Carlington 1980). The rollercoaster ride toward extirpation was on its last, fast downhill slide.

Despite these losses in Canada, the Swift Fox survived at the core of its range in the south-central plains region of the United States. In 1973, Miles and Beryl Smeeton acquired four Swift Foxes from the United States and brought them to the Wildlife Reserve of Western Canada, near Cochrane, Alberta and began captive breeding. By 1976, their success led the senior author to begin working with them to plan and execute the reintroduction of Swift Foxes into the Canada. This was begun through a series of graduate student projects (Carlington 1980, Reynolds 1983, Schroeder 1985) and the help of many others, especially Miles Scott-Brown. Since 1984, Charles Mamo has had primary responsibility for field portions of the project. The Canadian Wildlife Service joined in 1978 and Dick Russell participated until 1985 when he was replaced by Lu Carbyn who has played a major role since then. Significant financial contributions have been made by the Canadian

Wildlife Service, Alberta's Recreation, Parks and Wildlife Foundation, World Wildlife Fund (Canada), Esso Resources Canada Limited, the Calgary Zoo, the Wildlife Reserve of Western Canada, the Canadian National Sportsman's Show, The University of Calgary, Wyoming Game and Fish, Colorado Game and Fish, J. Fitzgerald, and area ranchers.

Swift Fox releases into Alberta began in 1983 and occurred each year since. In this paper, we discuss elements of survivorship, establishment, reproduction, and mortality during six years of releases from 1983 to 1988. These variables are interpreted in terms of the changed prairie ecology to evaluate the possibility of successfully re-establishing Swift Foxes on the Canadian prairie. Only the Alberta, and the Alberta-Saskatchewan border releases are discussed in this paper. Saskatchewan release results are discussed elsewhere (Carbyn and Kilaby 1989).

STUDY AREA

A detailed description of the Alberta release area is provided by Reynolds (1983). The release area encompasses the Lost River Ranch, a 22,792 ha cattle ranch owned and operated by Leonard and Mary Jane Piotrowski, the Onefour Agricultural Station operated by Agriculture Canada, and the Sage Creek Grazing Reserve, operated by Alberta Lands, Forests and Wildlife (Fig. 1). The area lies in the mixed prairie zone described by Coupland (1950) while Strong and Leggat (1981) characterize it as part of the Short Grass Ecoregion. Portions of the Onefour Station have been seeded to Russian Wild Rye (*Elymus junceus*) in the past while the entire Lost River Ranch area consists of native prairie.

The release area has a continental prairie climate characterized by cold, harsh winters, warm summers,

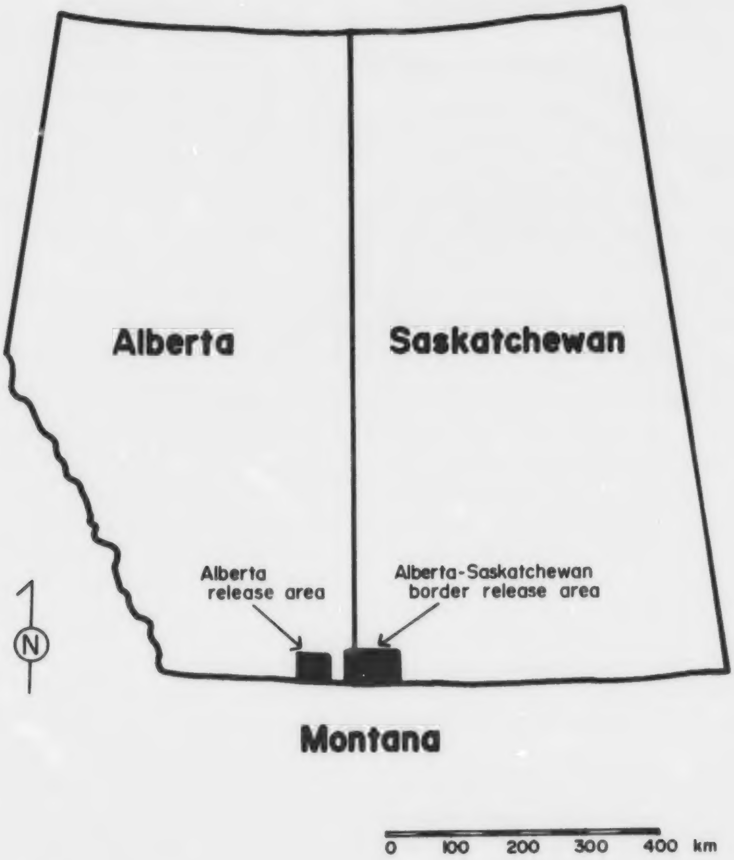

Figure 1. Map of Swift Fox study area

and low precipitation. Precipitation levels are the lowest in the Province: the mean yearly precipitation is 340 mm (range 260-380 mm). The Short Grass Ecoregion has the warmest summer temperature in Alberta. The mean May-September temperature is 15° C (range 14.5-16° C). Winters are characterized by cold temperatures and relatively little snowfall. The mean December-February temperature is -10.5° C. The combination of low temperatures and little snow cover results in harsh winter conditions for vegetation.

The terrain of the area is generally flat to gently rolling except where bisected by numerous coulees and runoff channels. Elevations average approximately 1000 m ASL. The Milk River forms the southern boundary of the study area along the Montana border.

Major habitat types in the study area include uplands, coulees, and badlands. The predominant vegetative association of upland types is the speargrass/blue grama association (Wallis 1976, as cited in Reynolds 1983). Vegetation in the coulee areas is variable. Slopes may be eroded or grassy and shrubs such as willow, rose, River Birch (*Betula occidentalis*), and Saskatoon (*Amelanchier alnifolia*) may be present. A cottonwood association is found in the Milk River Valley. Badland habitats are generally devoid of vegetation and only hardy species such as Greasewood (*Sarcobatus vermiculatus*), sage, pricklypear cactus, Winterfat (*Eurotia lanata*), and salt sage can survive (Reynolds 1983).

The area is generally remote and contains few inhabitants. Secondary Highways 501 and 502 cross the area and connect with Highway 41 to the east. Vehicle traffic on all roads is light.

The Alberta-Saskatchewan border release area is similar to the Alberta release area and includes portions of Alberta and Saskatchewan. It is, however, more arid and less incised by coulees. The northern border of this area is secondary Highway 501 and a few kilometres north of there. The southern border is the United States (Montana) border. Releases have occurred as far west as the Sage Creek Pasture in Alberta and as far east as the townsite of Govenlock in Saskatchewan.

The Alberta-Saskatchewan border release area appears different from the Alberta release area in that shrubs are less abundant and badgers (*Taxidea taxus*) and ground squirrels (*Spermophilus richardsonii*) are more abundant.

METHODS

Swift Foxes were captured primarily in Colorado, Wyoming, and South Dakota (Herrero et al. 1986) and became part of a captive breeding program in which the maintenance of genetic heterozygosity was a primary criteria for mate selection (Schroeder 1985). A few individuals have been released directly, after at least a 30 day quarantine, without being held for captive breeding. Four primary institutions or ranches have been substantially involved in captive breeding: the Wildlife Reserve of Western Canada, the Lost River Ranch, the Calgary Zoo, and the Moose Jaw Wild Animal Park.

Both soft- and hard-release methods have been used (Table 1). In the soft-release, pairs of foxes were typically held within large (3.7m x 7.3m) pens over winter. Foxes were then released either the following spring, if they had not mated, or early in the fall with their offspring, if they had mated. Supplemental feeding of soft-released foxes has often continued after the foxes were free-ranging. With hard-release, the foxes were set free in the fall without previously being held on site. There was no supplemental feeding until the winter of 1988/1989 when a combination of low prey populations and harsh temperatures jeopardized the survival of released foxes.

Ninety-six of 207 (30 hard-released, 66 soft-released) foxes have had radio-collars (Telonics and later Holohill) placed on them at the time of release and these have been changed as necessary and possible. Some individual foxes have been monitored for over 4 years and through several hundred relocations. Throughout, an attempt has been made to locate dead animals as soon as possible so that cause of death could be studied.

Table 1. Number of swift foxes released in Alberta and Alberta-Saskatchewan border area by year and release type.

Year	Type of Release		
	Soft	Hard	Total
1983-85	51		51
1986	8		8
1987	38	57	95
1988		53	53
Total	97	110	207

RESULTS AND DISCUSSION

During the initial years of the project (1983-1986), few foxes were released (N = 59; Table 1) and fairly intensive monitoring was done. In Alberta, all foxes were soft-released on the Lost River Ranch - Onefour Agricultural Station site. Enough was learned about Swift Fox ecology, especially factors influencing mortality, survivorship, establishment, dispersal, denning, and food habits (Herrero 1984, Scott-Brown et al. 1986, Carbyn 1986) that during 1987 we were ready to proceed with large-scale releases using both hard- and soft-release techniques.

During the fall of 1987, 57 hard-releases were carried out in the Alberta-Saskatchewan border area. The fall was mild and our impression was that grasshoppers and microtine rodents were abundant. A mild winter also followed. There was good establishment of hard-released Swift Foxes in the Alberta-Saskatchewan border release area. Nine of 17 radio-collared foxes were known to be alive and resident as of 10 March 1988. Others may have been alive or dead but could not be located, and two radio-collared, hard-released foxes were found dead. Most radio-collared, hard-released foxes did not move far. The average maximum dispersal distance was 9.3 km (N=15) and the mean distance to an established den site was 4.5 km (N=15). One fox released on 29 Sept. 1987 dispersed a long distance immediately (50 km) and was shot on/or about 12 Oct. 1987.

During the winter of 1987/1988, hard-released foxes appeared to have done well. Reproduction in spring and early summer of 1988 appeared good. Out of two litters that were located, a minimum of 12 pups were present. However, as the summer proceeded the cumulative effects of a drought took its toll. It was difficult to relocate foxes because budget constraints precluded more than minimal flying but it was apparent from ground searches that foxes had either dispersed from or had died in the Alberta-Saskatchewan border area, the driest of our release sites.

The 38 Swift Foxes soft-released in 1987 on the Lost River Ranch also did well initially. There were, however, 10 known mortalities by December 1988, but a minimum of 11 foxes were known to have survived through the mild winter. In spring and early summer of 1988, five litters were located having a minimum of 19 young. One pair of reproducing Swift Foxes, Samson and Grace, were both born on the Lost River Ranch, and were alive and free-ranging as of December 1988 for 1119 and 790 days respectively. This was their second litter as free-ranging Swift Foxes.

Soft-releases ended in 1987. Between 1983 and 1987, 97 Swift Foxes were released using this technique (Table 1). Most soft-released Swift Foxes remained in the vicinity of their pens (52 out of 83) and have periodically or regularly used these sites. The mean percentage of radio fixes at the release pen was 51.9% for all radio-collared, soft-released foxes. These data show that soft- or hard-release techniques can be used to get foxes to remain nearby release sites if local conditions are favorable.

During fall of 1988, 53 hard-releases and no soft-releases took place. Conditions were arid and unfavorable as mentioned. Twelve of the hard-released Swift Foxes were radio-collared. A week post-release only four could be located during a search flight. The remaining eight radio-collared foxes probably dispersed out of the study area. Aerial monitoring two weeks after release revealed three foxes that dispersed a mean distance of 8 km and that they seemed to be established in the study area. This contrasted markedly with the lack of dispersal of most radio-collared foxes that were hard-released during fall of 1987. One mortality is known among the radio-collared foxes released in 1988. This fox was killed 24 days later by a Coyote 9.5 km from its release site. After the two week, post-release monitoring flight, lack of funding prohibited further monitoring flights but limited ground work was done. As of March 1989 only one radio-collared fox is known to be alive. It appears to be part of a mated pair.

During the winter of 1988/1989, the effects of the drought took a toll on both hard- and soft-released Swift Foxes. Each of five foxes captured during early fall of 1988 weighed 200 to 350 g less than would be expected. Unfortunately, this happened at the same time that project finances reached a low ebb, precluding aerial or intensive ground monitoring. It appeared, however, that many foxes were in near starving condition and limited supplemental feeding was done. As of mid-March 1989 a minimum of 19 Swift Foxes were known to be alive throughout the release areas. More intensive searches would certainly reveal more.

Of the 207 released Swift Foxes, 37 are known to have survived 200 days or more; 18 of these survived for at least 360 days (a year). No doubt many other uncollared foxes also survived for long periods. The mean lifespan of foxes after release (N=74) was 273.1

days (S.E.+33.6, median=205.0, range=2 - 1550). The number of radio fixes for most (N=69) of these foxes was 38.7 (S.E.=22.0, median=6.4, range=0 - 277). This gives some indication of our monitoring effort.

Released foxes known to have died were categorized by cause of death (Table 2). It is clear that predation, primarily by Coyotes (*Canis latrans*), was the main known cause of death. A minimum of 22 out of 35 foxes (63%) were known to have died as a result of predation. Coyotes accounted for at least 12 deaths (36%). If we add two probable Coyote kills, then Coyote predation accounts for 40% of known mortality. We also suspect that many of the deaths attributed to "predation" (N=4), or to cause "unknown" (N=7) were also due to Coyotes. Where the cause of death was determined, predation accounted for 22 of 25 cases (88%). Known and probable Coyote predation accounted for 14 out of 25 cases (56%). These data are consistent with what Berry et al. (1987) have found regarding causes of mortality in the closely related San Joaquin Kit Fox (*Vulpes macrotis*). They reported that 121 (53.8%) of 225 kit foxes were known to have been killed by predators, mostly Coyotes.

Table 2. Causes of death of Swift Foxes known dead (N=35).

Predation	
Coyote	12
Probable coyote	2
Bobcat	2
Eagle	2
Unknown predator	4
Roadkill	3
Unknown	10
Other	3

CONCLUSIONS AND SPECULATIONS

We have shown that by using either soft- or hard-release techniques, and during favorable conditions, many Swift Foxes can be induced to remain in the area where they were released. Also, with favorable conditions, an adequate number can survive for a year or more and reproduce.

Despite these positive signs, we do not consider the Swift Fox re-established on the Canadian prairie. During the winter of 1987/1988 there appeared to have been good survivorship and the spring of 1988 brought evidence of significant reproductive success. But the prairie drought of the last few years became particularly severe during the summer of 1988. Many reintroduced Swift Foxes appeared to have dispersed, especially from the very dry Alberta-Saskatchewan border area. In apparent response to the drought, family groups broke up during summer rather than the normal fall period. Swift Foxes hard-released during fall of 1988 did not do well. Non-quantified field impressions were that the food base for Swift Foxes was depleted in direct response to the drought. Numbers of ground-nesting birds, rabbits and hares, small rodents, and even grasshoppers appeared to be low. These conditions persisted throughout the winter of 1988/1989.

Before the destruction of the Bison-based prairie ecosystem, Swift Foxes were a part of this complex system. They would have eaten many of the same foods they do today but also they periodically would have fed and fattened on Bison (*Bison bison*) carrion. Wolves, Grizzly bears (*Ursus arctos*), weather, disease, and other factors would have killed Bison. Swift Foxes would have scavenged what they could when carcasses were nearby, perhaps occasionally stealing bites from under the nose of the Grizzly Bear, much as the Arctic Fox (*Alopex lagopus*) will do today when Polar Bears (*Ursus maritimus*) are at their kills. Even wolves would probably have tolerated Swift Foxes more than they do Coyotes. Wolves compete less directly with foxes than they do with Coyotes. For example, when wolves invaded Isle Royale the Coyote soon went extinct but the Red Fox (*Vulpes vulpes*) survived (Allen 1974). With the current, virtual absence of wolves from the prairie, the Coyote has flourished but the Swift Fox has not. Our data on Coyotes killing Swift Foxes and that on the related kit fox (Berry et al. 1987) makes it clear that Coyotes can be the primary source of mortality for Swift Foxes. So not only is there less food for Swift Foxes today, but their most important competitor is more numerous.

Also, Badgers and ground squirrels appear to have played a fundamental role in Swift Fox ecology. Where locally abundant both species would have provided numerous holes in the ground and Swift Foxes would have used some of these holes to escape from predators. Swift Foxes also would have modified them to form dens. Ground squirrels would have not only provided holes but also would have been part of the food base for Swift Foxes. With both Badgers and ground squirrels being suppressed by ranchers and farmers, the prairie has become less favorable for

Swift Foxes. Initial high survivorship during the fall of 1987 when Swift Foxes were released into the Alberta-Saskatchewan border site, an area with high numbers of Badgers and ground squirrels, suggests the importance of these species to Swift Foxes. Another characteristic of the border area as Swift Fox habitat is its relatively flat and shrubless nature. Infrequent coulees and shrubs mean less chance for a Coyote to conceal itself from a Swift Fox.

Our attempt to reintroduce Swift Foxes has taught us much about the complex system that the fox was once part of. Today many aspects of the Swift Foxes' historic environment are still there but others are gone. The Swift Fox was once a vital part of the Canadian prairie but can it survive today? We are cautiously optimistic. By being released into areas that have escape terrain and an adequate food base, Swift Foxes will, over time, modify their environment by digging so that it becomes more suitable to their survival. Then, even if drought, disease, or other factors cause local population declines, they can later take advantage of their potentially high reproductive rate and re-establish themselves into an area where the habitat has been modified and "improved" by previously resident foxes. This is of course speculation on our part.

We believe that for a population of Swift Foxes to be established in Canada, the number of foxes would have to be large enough to withstand considerable environmental change and periodic local declines in Swift Fox numbers. Coyote predation will remain one of the major factors limiting Swift Fox numbers but, in southern portions of their range, Swift Foxes persist despite this. However, there they have habitat recently lived in by other Swift Foxes and they probably have a broader, more abundant, and reliable food base, coupled with a somewhat milder climate and probably more intense Coyote cropping.

Because of the complexity of factors influencing the Swift Fox in Canada, their future for now is indeterminate. The best way we have available to increase the odds for their re-establishment will be to continue to release significant numbers to help form a critical mass. Enough foxes must be released into a diversity of acceptable habitats so they can withstand changing environmental factors that make some areas poor habitat in certain years but good in others. We could also try to suppress Coyotes, something we have chosen to avoid, or we could try to rehabilitate a more complete prairie ecosystem by including free-ranging Bison, naturally regulating populations of Badgers and ground squirrels and perhaps even wolves. In such a system, there would very likely be a place for Swift Foxes. No matter which strategies are chosen, as long as we continue to try to reintroduce and study the Swift Fox, we shall learn more about the prairie and its complex web of life.

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A REVIEW OF THE NATIONAL FILM BOARD PRODUCTION OF "RETURN OF THE SWIFT FOX"

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My review of the film "Return of the Swift Fox" deals with three aspects: (1) artistic impression, (2) objectivity and scientific accuracy, and (3) importance to prairie conservation.

ARTISTIC IMPRESSION

Artistically, the film was a treat. Landscapes, colour, wildlife, and features are effectively intertwined with the message of the uniqueness of the Canadian prairies. The film captured the mood of a tragedy and the human willingness for reconcilation. The narrator's voice carried the message in a very pleasing way from beginning to end.

Specific comments that viewers offered, both positive and negative, include the following:

(1) The background music was superb and blended well into the narration. An approaching Coyote (*Canis latrans*) effectively evoked suspense and danger.

(2) Sounds were well chosen. One can feel wagons rumbling over the prairies. The Least Flycatcher's (*Empidonax minimus*) "chebec" call heard in the sequences taken at Wildlife Reserve was appropriate for the habitat. I was happy to hear the "gurgling of the coffee pot" sound emitted by alarmed foxes.

(3) Subdued conversation among researchers unloading and collaring foxes effectively brought the viewer into the scene.

(4) The variety of prairie creatures shown, from insects and rattle snakes to Burrowing Owls (*Athene cunicularia*), set the proper stage to highlight prairie diversity, beauty, and charm.

(5) The quality of photography was uneven. A hawk in flight and an Antelope (*Antilocapra americana*) were partly out of frame. Faces of people being interviewed were occasionally shaded. The sequence where a person was engaged in radio-tracking had a background which was poorly illuminated.

On the whole, the film was of high artistic quality. I scored it an 8 out of 10 on artistic impression.

OBJECTIVITY AND SCIENTIFIC ACCURACY

If there is one area where the film did not meet my expectations, it would be on objectivity and scientific accuracy. Twenty-five minutes is not a long time to present all the facts on the subject but errors could have been avoided by paying more attention to detail.

Some examples of inaccuracies or flaws in logic are as follows:

(1) Lynx (*Lynx canadensis*) are not normally predators of Swift Foxes (*Vulpes velox*). Replace Lynx with eagles in the script and the statement is correct.

(2) Ecosystems are never in a state of complete equilibrium. What evidence is there that Swift Foxes were a "part of the Canadian prairie landscape for thousands of years"? Their numbers could well have fluctuated in the past and it is not unlikely that they became extinct and recolonized their northern ranges.

(3) Release of foxes from release pens to the wild was not the only reintroduction method. Captured wild foxes can be released without holding them in captivity, as long as this has been approved by Animal Health authorities.

(4) Studies to date have shown that jack rabbits were not killed by Swift Foxes in areas where they were released in Alberta and Saskatchewan. Foxes have been found feeding on jack rabbits but these were all road kills. The night sequence, although powerful and charming, showed a carcass provided for filming purposes; a mention of that fact might be appropriate and it would not have detracted from the aesthetics. The impression left in the film was that the foxes had killed the rabbit. That was not the case.

(5) There is no proof that Swift Foxes disappeared in Canada in the 1940s; it could well have happened ear-

lier. The 1938 reference is from a newspaper article; newspapers are not considered to be an authoritative record.

(6) What evidence is there that starvation is not a major threat to Swift Fox survival? At the time that the film was being premiered on television, an emergency winter feeding program was being carried out in southern Alberta.

(7) Winter sequences are an obvious omission in the film. A brief discussion of the effects of winter on Swift Fox survival is required for a complete story.

(8) The film includes a few contradictions. For example, it is stated that foxes should live in people's backyards but the theme of the film is that wildlands, free from human manipulation, are required for wildlife. Also, following the statement that foxes are kept in pens that resemble, as much as possible, natural conditions, we see foxes being hand fed.

The film also is flawed on the logic that is being presented. How can the disappearance of Swift Foxes be directly attributed to habitat destruction and predator control in Canada when we know that the foxes are still common in parts of the United States? Predator control against Wolves began a lot earlier in the United States and was more intense than was the case for prairie areas in western Canada. the key for the Swift Fox's disappearance in Canada may well be related to the fact that it existed at the periphery of its range. Adaptation to northern conditions by an animal that essentially is a southern species, could well be the key to its survival in Canada. Such a very important idea should have been discussed in the film.

It is unfair for those interviewed not to have had the opportunity to evaluate their statements in their edited form before the film was considered finished. A correct statement in an interview can lead to embarassment for the person interviewed when it has been placed out of context in the film.

Perhaps these criticisms are "nitpicking" but, for objectivity and scientific accuracy, I gave the film a score of 3 out of 10. Each person seeing the film will have to come to their own conclusions. My experience with Wolves, Wolf conservation and all the debates surrounding that issue has made me aware of how much misinformation there can be about high-profile biological issues. Once established, misconceptions and myths become so entrenched that it is difficult to achieve a proper perspective on the subject. As the public becomes more informed and interested in biological issues, I believe that it is everyone's responsibility to give out only the most accurate information possible. Remember that this film will reach a potential audience of 20 million television viewers and, perhaps more significantly, the film will be available to schools. Providing viewers with incomplete or false information cannot be excused, no matter how important the message.

IMPORTANCE TO PRAIRIE CONSERVATION

The objective of the film was to show that the prairies have a precious heritage, much abused and greatly threatened. The film accents the positive, that something is being done about the problem. In the words of the producer, "It is not meant to be an Ooh-Aah film. Ooh how wonderful and aah how terrible!"

Has the film succeeded in sending out a message? The film has surpassed my expectations; I scored it a strong 10 out of 10. It would still have scored that high had it been more accurate in the information presented.

I was impressed by the human elements; the warmth and sincerity of the farmers interviewed captures the "soul" of the film. There is a much greater inspirational impact from farmers talking about their environment than from knowing that governments, industry, and private citizens have spent as much as half a million dollars to date on the Swift Fox reintroduction project. One can only hope that it will continue to inspire others.

For anyone who would like to experience the inspirational and aesthetic values of native prairie, I would suggest a trip from Consul, Saskatchewan to Manyberries, Alberta. Contrast it with travel from the south arm of Pakowki Lake to the town of Milk River. Then reflect on this quote from the film, "It is a desolate world we are creating for ourselves but perhaps we are finally beginning to realize it." I think that this film will help millions of viewers to realize that. We can only hope that most will agree with Lise Perrault "that there has to be some aesthetic appeal in life, something that we can behold that is beautiful, something that is more than we can even be by ourselves." It is a powerful message and I applaud the film makers for an artistic masterpiece. Let us hope that they will turn their attention to the Piping Plover

(*Charadrius melodus*), Plains Bison (*Bison bison bison*), horned lizards, and Blue Gramma Grass (*Bouteloua gracilis*) and weave it into the important elements of the Prairie Conservation Action Plan. Let us hope, though, that the information presented is more carefully reviewed than was the case for this film.

PLAINS BISON CONSERVATION IN CANADA

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INTRODUCTION

There are two living subspecies of the North American bison, the Plains Bison (*Bison bison bison*) and the Wood Bison (*Bison bison athabascae*), the latter being the largest terrestrial mammal on the continent. The Plains Bison once occupied the Great Central Plains of western Canada and the United States, numbering between an estimated 30 million and 75 million animals, while the Wood Bison ranged throughout the boreal forest regions of northwestern Canada (Fig. 1) and numbered approximately 168,000 (Soper 1941).

When European settlers first came to North America, the Plains Bison covered the prairies in such numbers it was difficult to believe that these great herds might ever disappear. Yet, this subspecies nearly became extinct between 1840 and the turn of the century through wanton destruction, regardless of the fact that no other animal has more deeply affected North American civilization than the bison (Roe 1970). The pioneer settlers were in pursuit of the land occupied by the bison and thereby nearly eliminated them.

North American bison have been rounded up, captured, transported, and manipulated, but they still have been able to maintain their wild nature. Unfortunately, it has been a constant struggle for survival against many human-caused adversities. Even after 80 years of efforts to preserve plains bison in Canada there is growing concern about the possibility of losing them, especially if a conservation strategy to increase numbers within their historic range is not soon developed. This situation is further complicated by the fact that major portions of prairie habitat have been lost to urban and agricultural development during the past 50 years. Free-roaming herds of Plains Bison are essentially incompatible with this development and, therefore, are an unlikely component of the Canadian prairie ecosystem in the foreseeable future. Areas for possible establishment of enclosed Plains Bison herds within their historic range in Canada are the relatively undeveloped and more isolated southern grasslands currently under the ownership and administration of the provinces and the federal government. Although millions of bison once roamed throughout much of North America, few free-roaming herds presently exist.

The majority of Plains Bison in Canada today are privately owned by commercial ranchers for the purpose of raising breeding stock and for the meat industry. On the other hand, Wood Bison, through their previous status as endangered and now as threatened wildlife, are not available for commercial purposes but may soon be available because of the pressing need to dispose of surplus stock. From a conservation point of view, it is unfortunate that both subspecies will readily interbred and produce hybrids that are fertile. Currently there are concerns that the release of Wood Bison to the private sector will place the genetic integrity of the Plains Bison as well as the Wood Bison at risk and possibly cause Plains Bison to become endangered.

There is an apparent need for governments to cooperatively assume the management responsibility necessary to secure the long-term conservation of Plains Bison in Canada, before it is too late.

The purpose of this paper is to identify some conservation concerns and to outline possible options for development of a Plains Bison conservation strategy.

HISTORICAL BACKGROUND

The rapid demise of the Plains Bison began around 1840. Pressure on the southern herds increased tremendously during the 1850s and 1860s with the establishment of railroads and settlement of the west. By the 1870s, hide hunters descended on the great plains seeking to supply a new demand for leather on European markets. The onslaught was phenomenal. By 1880, the southern herds were virtually eliminated and by 1884, the northern herds, located in Montana and Canada, were all but extinct. The decline was dramatic - some 30+ million bison were killed in less than 40 years. Were it not for a few small herds held by private ranchers, the Plains Bison would likely have become extinct.

One such herd was the Bedson herd, which originated from the capture of a few bison calves near

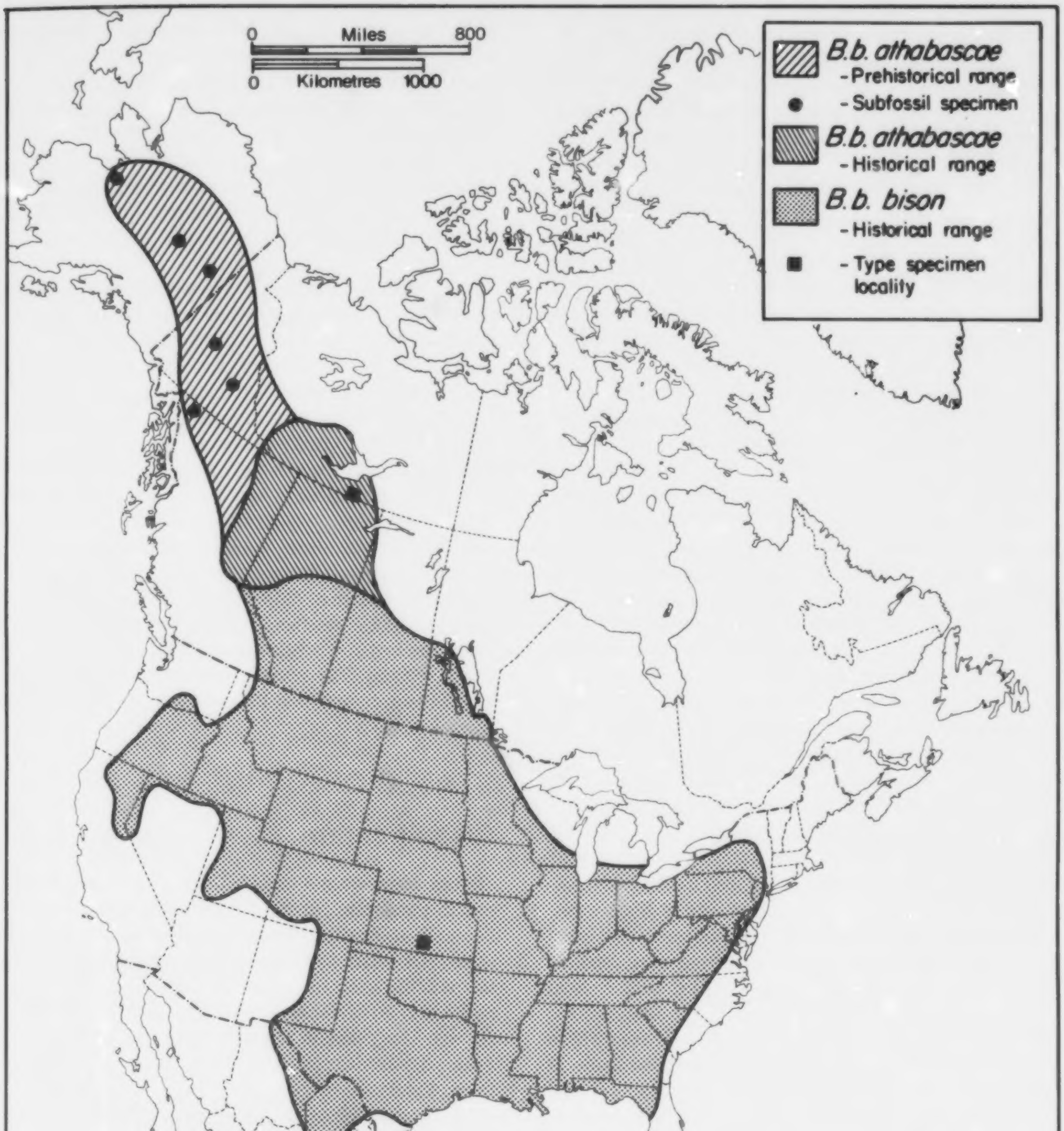
0 Miles 800
0 Kilometres 1000
B.b. athabascae
- Prehistorical range
- Subfossil specimen
B.b. athabascae
- Historical range
B.b. bison
- Historical range
- Type specimen locality

Figure 1 - Historic range of Plains Bison (*Bison bison bison*) and historic and prehistoric distribution of Wood Bison (*Bison bison athabascae*) (after van Zyll de Jong 1986).

Battleford, Saskatchewan, in 1873. This herd was raised in captivity near Stony Mountain, Manitoba, until 1887 when part of it was sold to "Buffalo" Jones in Kansas while the rest of the herd was donated to the government of Canada. Four bison from the Bedson herd were given to the City of Winnipeg while the remainder of the herd was shipped to Banff National Park in 1898. This marked the beginning of an era of conservation initiated by Canadian National Parks as part of the long road to recovery of the North American bison. Since then, the Canadian Parks Service has played a significant role in the conservation of not only Plains Bison, but that of Wood Bison as well. The Great Buffalo Saga continues.

A second major event that helped prevent the Plains Bison from becoming extinct is the story of the Pablo-Allard herd. In 1870, a few Plains Bison calves were captured in the Milk River drainage in southern Canada by Samuel Walking Coyote who later sold them to Charles Allard and Michel Pablo. This herd was maintained in the Flathead Valley in northern Montana. By 1885, the Pablo-Allard herd had increased to 300 animals, including some bison purchased from the "Buffalo" Jones herd. Allard's share of this herd was sold soon after his death in 1885. Some of his bison were used to repopulate Yellowstone National Park while other animals went to ranches in Oklahoma. Pablo retained his share of the herd until 1896 when settlement of the Flathead Valley forced him to sell. His initial offer to the United States Congress was rejected so Pablo agreed to sell his bison to the Canadian government.

The first 410 animals were shipped to Elk Island National Park in 1907 because the fence at Buffalo National Park near Wainwright had not been completed. In 1909, 325 plains bison at Elk Island were captured and moved to Wainwright in addition to 218 head shipped directly from Montana and 77 from the exhibition herd in Banff (Lothian 1981). From 1907 to 1912, Pablo managed to deliver 716 Plains Bison to Canada under the terms of his contract. The total number of bison introduced at Wainwright was 748. The Wainwright herd expanded to 1188 in 1913 and continued to increase to 6780 by 1923. The range was rapidly being depleted as it became over-crowded with bison.

Administrators at Buffalo National Park attempted to manage the herd by culling, but when they announced a major proposal for a phased slaughter program to control the herd, public criticism was so great that the plan was abandoned. A publicly more acceptable solution to the excess Plains Bison problem at Wainwright called for the shipment of animals north to the newly established Wood Buffalo National Park (Graham 1924). From 1925 to 1928, 6673 young Plains Bison were transported from Wainwright to Wood Buffalo National Park near Hay Camp (Lothian 1981). These bison were released at several sites along the west bank of the Slave River into ranges that were occupied by Wood Bison (Soper 1941).

The transfer of plains bison into historic range of the Wood Bison was seriously challenged by the American Society of Mammalogists (Howell 1925) and by other biologists (Harper 1925; Saunders 1925) for fear that interbreeding would cause the loss of both subspecies and result in the transmission of disease to the northern Wood Bison population. As it turned out, scientific evidence was largely ignored and the transplant proceeded in an effort to appease public pressure. Tuberculosis had been identified in the Wainwright herd since 1919, so only young bison were transferred in the mistaken belief that tuberculosis was a disease of older animals. Subsequently, the two subspecies interbred, as had been predicted, which resulted in a hybrid diseased population that exists there today. The recovery and conservation of the Wood Bison from Wood Buffalo National Park is yet another story.

STATUS OF PLAINS BISON

Classification

Plains Bison are not classified as wildlife within the prairie provinces, but are considered to be domestic livestock. In British Columbia, Plains Bison are designated as wildlife and are classified as "big game" in the Wildlife Act. In addition, Plains Bison may be raised in captivity under permit issued by the Wildlife Branch. The Yukon Fish and Wildlife Branch is establishing a policy to prohibit importation of Plains Bison to the Yukon. Plains Bison have never been classified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) although a draft status report is currently under review. Administrative safeguards that are in place to protect Wood Bison are essentially non-existent for Plains Bison.

In western Canada, bison ranching is a rapidly expanding industry that is being promoted as a means of agricultural diversification. Because of similarities to the cattle ranching industry, it is likely that bison ranching will be subject to the same influences. There will be economic incentives for commercial Plains Bison ranchers to use Wood Bison in their breeding programs in seeking greater returns by producing larger slaughter animals. Inquiries as to the availability of Wood Bison stock for this purpose have already been received from ranchers in Alberta. The genetic integrity of Plains Bison in Canada will be threatened with hybridization unless sufficient safeguards to preserve the gene pool are instituted.

Population Size In Canada

The total Canadian Plains Bison population is estimated at 13,000 (Judd Bunnage, Alberta Agriculture, pers. comm.); however, the majority of animals are contained in privately-owned commercial herds throughout western Canada. Government controlled or publicly owned herds of Plains Bison account for less than 10% of the total Canadian population. The recovery of Plains Bison in Canada was initiated by national parks. Today five such parks accommodate approximately 500 Plains Bison (Table 1); however,

Table 1 - Public herds of Plains Bison in Canada in 1988.

1. NATIONAL PARKS	
Elk Island	340
Riding Mountain	46
Waterton Lakes	23
Prince Albert (Paddock Herd)	11
Rocky Mountain National Historic Park	30
Subtotal	450
2. FREE-ROAMING	
Pink Mountain - B.C. (within range of Wood Bison)	500
Prince Albert National Park - Saskatchewan	55
Primrose Air Weapons Range (Military Base) - Alberta/Saskatchewan	35
Subtotal	590
3. OTHER PUBLIC HERDS (CAPTIVE)	
Wainwright Military Reserve	14
Suffield Military Reserve	16
Buffalo Pound Provincial Park	15
Prince Edward Island	22
Quebec Zoo (Provincial)	6
Magnetic Hill (Municipal)	2
Winnipeg Zoo (Municipal)	5
Subtotal	80
GRAND TOTAL	1120

about 75% of these animals are maintained at Elk Island National Park in one large herd. The Elk Island herd has free access to approximately 130 km^2 of range within fenced boundaries of the park. This herd is managed as one of the components of the aspen parkland grazing system and also for preservation of the Plains Bison gene pool. Biannual herd reductions of 150-200 animals occur by sealed bid tender sale as part of the park management plan. The present management objective is to allow the population to slowly expand to the ecological carrying capacity of the habitat, estimated to be 1000 animals, rather than managing for a specific population size between 350 and 600 animals.

Four other national park herds consist of small display groups in fenced paddocks of varying sizes. Bison in these parks are managed solely to provide viewing opportunities for the public and do not represent natural populations (Bertwistle 1988). All park bison are protected by legislation under the National Parks Act. At present, the Canadian Parks Service represents the only remaining government agency dedicated to the preservation of the Plains Bison subspecies.

Currently, there are three free-roaming herds of Plains Bison in Canada (Table 1). The Pink Mountain herd, located in northeastern B.C., originated from the escape of privately owned Plains Bison purchased at an Elk Island National Park sale in 1971; however, they currently occupy an area within the identified historic range of the Wood Bison. The ownership of the Pink Mountain Plains Bison herd has been contested in the law courts during the past several years. The latest decision has ruled in favour of the Crown, but that decision is currently under appeal by the private owner. The future of this population is somewhat dubious and, therefore, the herd should not be included in any conservation action plan until the issue is resolved. The other two free-roaming herds in northwestern Saskatchewan, the Prince Albert National Park wild herd and the Primrose Air Weapons Range herd, are descendants of the Saskatchewan Thunder Hills transplant in 1969. This stock also originated from Elk Island National Park. The total number in these two herds approximates 90 animals which is relatively small from a conservation standpoint; however, these herds have been increasing during the last few years. Also, these populations are located near the northernmost fringe of historic range for Plains Bison in North America. Their existence in these locations only marginally represents conservation of a native species in native habitat.

Three of the seven other public herds of Plains Bison in Canada, that is, those at Wainwright, Alberta; Suffield, Alberta; and Buffalo Pound Provincial Park, Saskatchewan; are maintained as purebred breeding stock for public display and historical purposes, but these herds contain less than 50 animals in total.

The total number of Plains Bison in public herds in Canada in 1988, including those free-ranging in northeastern B.C., is just over 1100 animals (Table 1). Without including the Pink Mountain herd in the free-roaming group, the conservation picture becomes rather bleak at a mere 620 Plains Bison. It is rather unfortunate that the total number of Plains Bison under government control in Canada today is less than the number originally purchased from Pablo in 1906 to preserve the subspecies from extinction.

When comparing the Canadian Plains Bison scene to the Wood Bison recovery program, which has been ongoing for more than 25 years, it is evident that three free-roaming herds and one fenced semi-wild herd contribute in excess of 2300 Wood Bison, three fenced herds for future reintroduction add another 245 animals, and six captive breeding herds in Canadian zoos contribute another 120 Wood Bison towards conservation of the gene pool (Table 2). In total, there are more than 2700 Wood Bison in public herds in Canada. Excluding the Pink Mountain herd, this represents more than four times the number of Plains Bison that are presently maintained in public herds in Canada for protection of the Plains Bison gene pool.

Population Size In The United States

The status of Plains Bison from a North American perspective, however, is much more secure. This security stems from positive conservation measures implemented by the United States government to protect Plains Bison after they were nearly exterminated at the turn of the century. Although there are approximately 100,000 Plains Bison in the United States, only about 10% of them are in public herds with the remainder belonging to private commercial operations. According to a 1987 census, there are at least 17 herds in nine different states that protect a total of 4315 Plains Bison (Table 3). In addition, four U.S. national parks play an important role in conser-

Table 2 - Public herds of Wood Bison in Canada in 1988.

1. FREE-ROAMING	
Mackenzie Bison Sanctuary	2000
Nahanni-Liard	35
Nisling River	22
Subtotal	2057
2. FENCED SEMI-WILD	
Elk Island National Park	300
Subtotal	300
3. FENCED FOR REINTRODUCTION	
Nisling River - Yukon	26
Waterhen - Manitoba	185
Hay-Zama - Alberta	34
Subtotal	245
4. CAPTIVE BREEDING HERDS	
Calgary Zoo	2
Valley Zoo	2
Alberta Wildlife Park	45
Banff National Park	9
Moose Jaw Wild Animal Park	26
Metro Toronto Zoo	36
Subtotal	120
GRAND TOTAL	2722

vation of Plains Bison by protecting at least 4000 animals, while four national wildlife refuges account for an additional 1565 Plains Bison (Table 3). In total, the 1987 census for Plains Bison in the United Sates indicates that nearly 10,000 bison are being protected in at least 25 public herds for conservation of the gene pool. It is apparent that, from a continental viewpoint, Plains Bison are not in any significant jeopardy; however, from a Canadian perspective, the situation warrants immediate action to develop a sound conservation strategy.

The security of Plains Bison in the United States may be threatened if and when Wood Bison or their sperm are sent to breeders south of the U.S. border. American authorities should be made aware of the risk to the Plains Bison gene pool from interbreeding with Wood Bison prior to Wood Bison being released to the private sector in Canada.

CONSERVATION CONCERNS

As the recovery program for Wood Bison advances, the need to dispose of surplus stock constantly increases. The Wood Bison Recovery Team has identified five options for disposition of surplus Wood Bison: live sales, sport hunting, releases to the wild, the meat industry, and display herds. Within the Wood Bison Recovery Program, there is an immediate requirement to plan for the disposition of surplus stock from several ongoing projects. Of the five options, live sales has the greatest potential to create conservation problems for Plains Bison and, presently, is the most controversial option. In any case, the release of

Table 3 - Public herds of Plains Bison in the United States in State Herds, National Parks, National Wildlife Refuges, and other herds in 1987.

1987 Census - Public Herds

Location	Animals
1. STATE HERDS[4]	
ALASKA (free-roaming)	
Delta Junction	450
Farewell	275
Copper River	120
Chitina	70
Subtotal	915
UTAH	
Antelope Island State Park	470
Henry Mountain, (free-roaming)	400
Subtotal	870
SOUTH DAKOTA	
Custer State Park	1450
Subtotal	1450
ARIZONA	
House Rock Ranch	130
Raymond Ranch	110
Subtotal	24
KANSAS	
Maxwell State Game Refuge	240
Garden City State Game Refuge	135
Kingman State Game Refuge	15
Subtotal	390
NEBRASKA	
Fort Robinson State Park	325
Wild Cat Hills State Park	10
Subtotal	335

Table 3 (cont.)

MINNESOTA	
Blue Mounds State Park	65
Subtotal	65
WYOMING	
Hot Spring/Glendo State Park	45
Subtotal	45
IDAHO	
Three Island State Park	5
Subtotal	5
TOTAL - STATE HERDS	4315
2. NATIONAL PARK HERDS	
Yellowstone - Wyoming (free-roaming)	2500
Wind Cave - South Dakota	410
Badlands - South Dakota	560
Theodore Roosevelt - North Dakota	575
TOTAL - NATIONAL PARK	4045
3. NATIONAL WILDLIFE REFUGE HERDS	
Wichita Mountains - Oklahoma	700
National Bison Range - Montana	450
Fort Niobrara - Nebraska	380
Sulley's Hill - North Dakota	35
TOTAL - NATIONAL WILDLIFE REFUGE HERDS	1565
4. OTHER HERDS	
Tennessee Valley Authority Land Between The Lakes - Kentucky	70
TOTAL - OTHER HERDS	70
GRAND TOTAL - U.S. PUBLIC HERDS	9995

Wood Bison to the private sector for commercial development through live sales is likely to become a reality in the not too distant future. Hybridization and selection through the crossbreeding of Plains Bison with Wood Bison will undoubtedly be a major thrust of the fledging industry. The fact that the commercial bison industry is motivated by economics will lead to hybridization of both subspecies under the assumption that the hybrid will provide the best dollar return.

From a conservation standpoint, what are the implications of releasing Crown-owned Wood Bison to the private sector for commercial trade on the conservation of Plains Bison in Canada and the United States? Will the North American gene pool of Plains Bison be secure once live sales of Wood Bison are permitted?

There are valid concerns that sufficient safeguards to protect the Plains Bison gene pool, at least in Canada, are not yet in place. There is a need to establish additional populations of sufficient size, if the conservation of Plains Bison is to be guaranteed. The same down-listing and delisting criteria as established for Wood Bison should also be applied to safeguard the Plains Bison gene pool.

The status of Plains Bison in Canada has not been identified or properly assessed which is cause for another conservation concern. Are there sufficient numbers and herds of wild and captive stock available to protect and secure the gene pool? It is now apparent that all levels of government should cooperatively develop a conservation strategy that will guarantee the survival of Plains Bison in Canada.

The introduction of Plains Bison into Wood Buffalo National Park was a mistake that nearly caused extinction of the Wood Bison. It was a two-fold biological tragedy that brought wrong genetics and bovine diseases to the original resident Wood Bison. Now, the successful recovery of the Wood Bison has the potential to cause destruction of the Plains Bison gene pool, especially if appropriate management actions cannot secure the preservation of the genetically different subspecies of Wood Bison and Plains Bison.

The Alberta Fish and Wildlife Division has indicated that management of bison within their jurisdiction is dependent on a clear distinction between Wood Bison and Plains Bison. If the ability to distinguish between the two subspecies in the wild as well as in captivity is lost, then the status of Wood Bison as wildlife in the province would have to be withdrawn. There is concern that live sales of Wood Bison in other jurisdictions may stimulate a lobby to permit live sales in Alberta. If that happens, Wood Bison would have to be deregulated as wildlife and Alberta would be forced to withdraw from the recovery program for Wood Bison. Alberta has indicated that in order for them to continue to manage Wood Bison as wildlife in the province, all free-ranging bison will have to be Wood Bison while privately owned stock will have to be Plains Bison.

OPTIONS FOR A CONSERVATION STRATEGY

1. The first major conservation option is the specific need to establish at least two more large, (in excess of 200 animals each) publicly owned herds of Plains Bison on provincial or federal lands within traditional historic range. Large land bases, under provincial or federal ownership and administration, that still exist within the grasslands region of Canada are as follows:

a) National or Provincial Parks - the prime example here is Grasslands National Park in southern Saskatchewan.

b) Military Reserves - three good examples located within traditional Plains Bison range are: i) Wainwright in south central Alberta (the original Plains Bison preserve); ii) Suffield in southeast Alberta; iii), and Dundurn in central western Saskatchewan.

c) Community Pastures - such as the large tracts of federal Prairie Farm Rehabilitation Association (PFRA) pastures in southwestern Saskatchewan.

It is apparent that preservation of specific grassland habitat for the primary purpose of protection of Plains Bison is not presently being considered in Canada. National Parks initiated a conservation strategy for Plains Bison at the turn of the century. Now, 80 years later, it appears that this responsibility has once again been left to the federal government, specifically the Canadian Parks Service, to retain their role as guardians of the bison by providing adequate habitat and protection. Obviously, Grasslands National Park would be the logical place to launch a Canadian recovery program. In the interim, the Canadian Parks Service should continue to maintain the five paddock-display herds currently operating under their administration. These are important not only for public viewing and education, but also for their conservation value.

2. A second major conservation option is to identify all areas within the historic range of Plains Bison where wild populations have been established or could be established. A management plan to exclude privately owned captive or free-ranging herds of Wood Bison from these areas should be designed and implemented. The reverse scenario would be equally applicable, that is, establishment of Plains Bison herds within the historic range of Wood Bison should be restricted.

One possible solution to the concerns raised by the Alberta Wildlife Agency regarding live sales of Wood Bison, would be to prohibit the sale of Wood Bison to private commercial operators. This would prevent hybridization of Wood and Plains Bison within the specified jurisdiction.

Another modification of this option would require legislation to regulate Plains Bison as wildlife. Because Plains Bison have been deregulated within Alberta, the Fish and Wildlife Division no longer considers this to be a feasible option. Legislated regulations could serve to resolve the Alberta problem; however, it is recognized that this is an unlikely proposition because of the perceived public opposition to such drastic changes. Regardless, it is now important to encourage provincial and territorial jurisdictions to re-examine the need to develop regulations to deal with problems of hybridization, if the gene pools for Wood and Plains Bison are to be preserved.

3. A third major conservation option is to establish a three-level production classification system for bison. This would require cooperation of Agriculture Canada and the private industry to develop a registry for accreditation of purebred lines of captive Wood and Plains Bison. A suggested three-level system is as follows:

Level 1 - Represents wild free-roaming and fenced semi-wild populations. This level warrants the highest priority for conservation; however, registry would not be required (e.g., Mackenzie Bison Sanctuary and Elk Island National Park herds).

Level 2 - Represents large-scale commercial operations of varying degrees of low-level management intensity. However, purebred stock is maintained as part of a conservation philosophy that ensures preservation of genetic lines. Subdivisions could be structured within this category according to the management objectives of the operation.

Level 3 - Represents privately-owned stock in commercial herds where the owners agree to maintain purebred animals and register these animals under the Livestock Pedigree Act.

Levels 2 and 3 would require registration under the Livestock Pedigree Act. Agriculture Canada is willing to cooperate in the development of registries if support from two or more provincial agencies is obtained.

CONCLUSION

It is imperative that genetically separate Wood Bison and Plains Bison be maintained in sufficient numbers, whether in wild herds, semi-captive herds, or captive breeding herds in zoos, to ensure the preservation of both subspecies. Public herds will provide needed insurance that the gene pool is secure so that future generations of people will be able to view and enjoy bison. Although hybridization of some Wood Bison and Plains Bison is expected to occur within the industry, establishment of sufficient numbers of public herds of both subspecies will alleviate those conservation concerns.

It is rather ironical that the conservation of Plains Bison nearly caused the extinction of the Wood Bison, and now, the recovery and ensuing conservation of Wood Bison has the potential to cause extinction of the Plains Bison gene pool in Canada if appropriate action is not taken. Successful conservation measures for one species or subspecies may create problems for another, therefore, wildlife agencies must continue to exercise conservation consciousness for both.

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6. OTHER EXAMPLES, OTHER LESSONS

THE ST. LAWRENCE BELUGA: A CONCERTED EFFORT TO SAVE AN ENDANGERED SPECIES

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INTRODUCTION

In September 1988, more than 300 participants attended the First International Forum for the Future of the Beluga held in Tadoussac, Québec. This Forum, organized by the Fondation pour la sauvegarde des espèces menacées (FOSEM), was intended to contribute to the development and implementation of a survival strategy for the endangered St. Lawrence Beluga by bringing together representatives of all parties concerned. Exceeding all expectations, this event caught the attention of the press and the general public in such a way that the white whale of the St. Lawrence became a prominent symbol of our growing concern for the environment in the Province of Quebec. This paper is intended to present an overview of the facts and efforts that contributed to the success of the Forum as a case study showing how contributions from non-government organizations and from the general public can help to improve the situation of an endangered species.

DETERMINING THE STATUS OF THE ST. LAWRENCE WHITE WHALES

The Beluga (*Delphinapterus leucas*) is a medium-sized whale that is primarily found in Hudson Bay, Greenland, the St. Lawrence River, and the arctic coasts of Canada, Alaska and the Soviet Union. With a world population totalling around 50,000 (Reeves 1989), the species as a whole has been appointed an insufficiently known status by IUCN (1988). Although there is no evidence of subspecies distinctiveness in the Beluga, some populations of white whales seem isolated and are severely depleted. In Canada, the Beluga population of the Eastmain River is considered threatened while the populations of Ungava Bay and the St. Lawrence River are described as endangered (COSEWIC 1988).

The small Beluga population that still resides in the St. Lawrence River was officially declared as endangered in 1983 following the recommendations made in a report sponsored by World Wildlife Fund Canada and prepared by Leone Pippard, an independent researcher. For Leone Pippard, this declaration followed almost 10 years of efforts to persuade Canadian authorities that the white whale of the St. Lawrence was on the verge of extinction. As early as 1975, Pippard and her colleague Heather Malcolm did a survey of the Beluga population at the mouth of the Saguenay River under the auspices of Parks Canada and counted only 350 whales in an area where as many as 5000 animals freely roamed less than 100 years ago (Pippard and Malcolm 1978, Mitchell 1974). At the time, commercial hunting of the whale was the suspected cause of this depletion. It was known that the St. Lawrence Beluga as well as other whales had been hunted for their blubber as early as the 16th century; the ships of the Basques sailed up the estuary as far as Trois-Pistoles, a few miles upstream from the Saguenay River. In the early 1930s, the Beluga hunt markedly increased when the whale was accused by local fishermen of being an important predator of cod and salmon. Between 1932 and 1938, the Government of Quebec offered a $15 bounty for each Beluga killed. Worse than that, during the late 1920s or early 1930s, the government went as far as to allow the Canadian Air Force to use the whales as targets during bombing exercises (Reeves and Mitchell 1984). Questioning these practices, Dr. Vadim Vladykov, an ichthyologist for the Quebec Department of Fisheries, undertook in 1938 a major study of the general biology and feeding habits of the whale and mapped its distribution in the St. Lawrence estuary (Vladykov 1944, 1947). He showed that the white whale was rather an opportunistic feeder that fed mainly on capelin, sand lance, marine worms, and squid and that these whales could not be held responsible for the depletion of the salmon or cod stocks. By 1960, the commercial white whale hunt quietly ceased due probably to a lack of markets for whale products and to the great depletion of the whale population that numbered less than 1200 animals at that time.

The growing public interest in those giants of the sea prompted the Montreal Zoological Society in 1970 and 1971 to organize three whale-watching excursions between Rimouski and the Saguenay River (Sergeant and Hoek 1973). Attracted by this phenomena, two private researchers Leone Pippard and Heather Malcolm started their studies of the Beluga in 1975. Their results were unexpected. As noted previously, they estimated that fewer than 350 white whales could still be found in the estuary (Pippard and Malcolm 1978). These alarming findings prompted the Government of Canada to modify the Canadian Fisheries Act in order to prohibit harassment and hunting of the St. Lawrence white whale as of 1979 (Pippard 1980). That same year, la Société linnéenne du Quebec launched its own program of whale-watching excursions. This initiative marked the birth of a local industry that in 1987 alone attracted some 40,000 tourists from all parts of Canada, the United States and Europe (Parent and Drouin 1988). Blue (*Balaenoptera musculus*), Minke (*Balaenoperta acutorostrata*), Finback (*Balaenoptera physalus*), and Humpback Whales (*Megaptera novaeangliae*) were also regularly observed in the St. Lawrence.

Soon it was feared that the growing boat traffic associated with these excursions would be detrimental to the whales. In 1982, the Department of Fisheries and Oceans created an advisory committee with representatives of the whale-watching industry. This committee issued a series of guidelines to control Beluga and cetacean watching in the St. Lawrence River in order to eliminate the risks of harassment (Fisheries and Oceans Canada 1988).

REVEALING THE EFFECTS OF WATER CONTAMINANTS

Water pollution was suspected in 1978 of contributing to the decline in white whale numbers (Pippard and Malcolm 1978). The presence of very high levels of contaminants such as mercury, DDT, and PCBs in the tissues of these whales was reported for the first time in 1980 (Sergeant 1980, 1986). Not until 1986 did the effects of these contaminants on the whales become known when Pierre Béland and Daniel Martineau began publishing the results of autopsies performed on beached animals. They reported the incidence of pathologies never before described in cetaceans: bladder cancer, fibrosis of the spleen, and a herpes-like viral infection of the skin. They also detected a total of 24 different contaminants including mirex, DDT, PCBs, and PAHs in the tissues of these animals (Béland and Martineau 1986). The presence of PAHs (polycyclic aromatic hydrocarbons) was especially alarming. These contaminants, resulting from incomplete combustion of organic material, are known to be highly noxious. They are mainly produced by aluminum production plants, refineries, and automobile engines (Béland 1988). Some, like Greenpeace, were quick to associate the discovery of a bladder cancer in a Beluga with the unusually high incidence of the same disease among ALCAN aluminium workers in Jonquière, an industrial town situated a few kilometres up stream from Tadoussac along the Saguenay River.

THE NEED FOR CONCERTED EFFORTS

Greenpeace in 1983 had started a vast project to arouse public interest in the endangered Beluga. Greenpeace efforts culminated with the climbing of ALCAN smoke stacks in Jonquière in 1986. A few months later, ALCAN invited representatives of conservation groups to their head office in Montréal. The purpose of the meeting was to look for practical solutions to save the whales.

After a few meetings where all parties exchanged information, FOSEM, a private foundation dedicated to endangered wildlife, offered to organize a forum where researchers, government agencies, non-government organizations (NGOs), private companies, and representatives of the local community would present information and possible solutions for discussion. Gaining unanimous support for this idea, FOSEM created an organizing committee involving three government departments (Fisheries and Oceans Canada, Environment Canada, Environment Quebec), three NGOs (Greenpeace, Société linnéenne du Québec, Conseil régional de l'environnement du Saguenay-Lac-Saint-Jean-Chibougamau), and one company (ALCAN) that became the main sponsor of the event.

The announcement of the Forum in June 1987 put some pressure on the Ad Hoc Committee for the Conservation of the St. Lawrence Belugas, a committee created in January 1986 by Fisheries and Oceans Canada to devise cooperative measures for the protection of this threatened species (Fisheries and Oceans Canada 1987). The eight committee members, representing four federal and four provincial departments, issued a report in December 1987 that identified chemical contamination and disturbance as key factors affecting the Belugas. This statement was followed 6 months later by the announcement from Fisheries and Oceans Canada and Environment Canada of an action plan for the survival of the St. Lawrence Beluga. It was expected that this plan would serve as a basis of discussion for the Forum.

INVOLVING THE LOCAL COMMUNITY

Right from the start, the organizers of the Forum recognized the importance of involving the local population in the development and implementation of a survival strategy for the whales. FOSEM also decided to devote a significant effort to publicize the event. Thus, in the early summer of 1988, two members of the organizing committee met in Tadoussac with representatives of the local chambers of commerce, tourism associations, whale-watching excursion companies, and mayors of the local municipalities to ask for their collaboration. A special issue of the Quebec environment magazine Franc-Nord, devoted entirely to endangered wildlife and to the Beluga, served as the official vehicle of the Forum. This magazine was sent out to hundreds of organizations and individuals together with a formal invitation to the Forum and was distributed to every household in Tadoussac. A "Let's Save the Beluga" button was sold by the thousands. A poster announcing the event was posted on excursion boats and at different public locations in and around Tadoussac.

A FORUM FOR THE WHALES

On September 29, 1988, more than 300 people including some 55 journalists invaded the little town of Tadoussac. Thirty scientists, leading authorities on the Beluga, presented their latest data on the status of the whale population, its distribution in the estuary and an evaluation of the quality of the Beluga's natural environment and of the impacts of water pollution on the health of the whales. While giving all participants an opportunity to get a detailed portrait of the situation, these technical presentations brought up many suggestions for future research efforts. There was a clear need to pursue and expand the annual surveys in order to determine population trends and population structure and to identify critical habitats. Needs were also expressed for better knowledge of water pollution levels in the St. Lawrence and their effects on the different components of the ecosystem. Scientists unanimously agreed on the need for better coordination of research efforts.

In a second part of the Forum, the action plan to be implemented to save the Beluga was discussed by representatives of government and NGOs. National organizations like World Wildlife Fund Canada, Canadian Nature Federation, Canadian Wildlife Federation, and Greenpeace were among the participants. Provincial groups such as the Union Québécoise pour la Conservation de la Nature (UQCN) and local organizations such as Association touristique de Charlevoix, the Municipality and the Nautical Park of Tadoussac also participated. Industry was represented by ALCAN, Hydro-Québec, and Ultramar Canada. For most of the participants, the Forum represented a long-awaited opportunity to express their concerns and present their recommendations about the Beluga. Some groups took advantage of the Forum to publicly announce their intention to undertake direct actions in the form of research or education programs.

The participants unanimously supported the creation of a marine park at the mouth of the Saguenay and stressed the necessity of open cooperation and discussion between representatives of the local community, NGOs, and provincial and federal authorities in the planning and management of the future park. Some participants suggested that the proposed park boundaries be expanded to include a more substantial part of the white whale's habitat. The Beluga was naturally proposed as the official emblem of the future park.

Continuous reporting to the public on the status and progress of the whale population was considered a priority by most groups. The Department of Fisheries and Oceans then announced its intention to publish an information bulletin on this subject on a regular basis (The first issue of the bulletin was issued in June 1989). L'Institut national d'écotoxicologie du Saint-Laurent took the opportunity offered by the Forum to launch their adopt-a-Beluga program which was intended to raise funds for their research projects. World Wildlife Fund and ALCAN jointly announced their financial contribution to the Institute's research program. Whale-watching excursion companies and other local organizations reaffirmed their intention to pursue their public education efforts. La Société linnéenne du Québec announced the creation of an International Interpretation Centre on the Beluga and the creation of the Vladykov Award to be awarded annually to recognize any outstanding contribution to the knowledge of the Beluga.

Conscious that boat traffic could disturb the whales, all participants strongly opposed any relaxation of the existing guidelines regulating whale-watching activities. One participant proposed restriction of the number of whale-watching permits.

As expected, the contamination of the St. Lawrence waterway stood out as a prominent concern for most environmental groups. Understanding that a major part of the pollution affecting the Belugas originates from the Great Lakes, Greenpeace and la Société pour vaincre la pollution (SVP) supported ongoing negotiations between Canada and the United States to end PAH and PCB emissions by industries in the frontier area between Quebec and New York State. They also insisted on the direct participation of the Quebec Government in these negotiations. Many groups asked for a stronger application of the Environmental Protection Act and urged the Department of Fisheries and Oceans to make use of the Fisheries Act on a more regular basis to discourage further degradation of fish and whale habitat. Pulp and paper industries were also urged to cease releasing dioxins and organochlorines into the water system. L'union québécoise pour la conservation de la nature, the most important conservation group in Quebec, stressed the importance of implementing a global strategy for the St. Lawrence and announced its own contribution through research and education programs. The Quebec Department of Environment reiterated its firm intention to implement an industrial depollution strategy and to oppose any delay in the closing of old Soderberg aluminum plants in Jonquière (an important source of PAHs) after the inaugeration of the new ALCAN plant in Laterrière. All these considerations were viewed by the federal and provincial governments as of major importance in the implementation of their St. Lawrence Action Plan, a plan that will mean a $110 million investment in the next 5 years on the part of Environment Canada and Fisheries and Oceans Canada.

FOLLOWING UP ON THE FORUM

A strong consensus was met at the Forum on the need to establish a follow-up committee, consisting of the members of the Forum's organizing committee, to pursue the suggestions made by participants and to update the Action Plan for the Beluga. That committee was created and has already met.

EVALUATING THE FORUM

Unfortunately, but quite expectedly, a deep-rooted frustration was expressed when the participants realized that the Forum itself could not settle in one weekend all the problems that the whales were facing. Nevertheless, the Forum definitely acted as a catalyst that accelerated the pace of the different government departments involved and urged NGOs to become active on this matter. The Forum also contributed to the integration of efforts of all parties involved. It developed collaboration between different actors and brought new contributors into action. More than anything else, it allowed a local community to get thoroughly informed and deeply involved in the survival of an endangered species.

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TROPICAL RAINFORESTS: STATUS REPORT WITH HINT OF OPTIMISM

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Tropical moist forests cover approximately 7% of the planet's land surface straddling the equator. The three major areas of tropical rainforest are the Amazon, west-central Africa, and southeast Asia. These forests contain at least 5 million species of the earth's flora and fauna (Morell 1990). Additional research has lead to estimates of over 30 million species on earth (Erwin 1983) with over 80% found in the tropical rainforests.

Half the area of the moist forest region, approximately 8 million km^2, has been removed from a climax state through various anthropogenic processes. By the early 1980s, 100,000 km^2 of forest were being eliminated annually through agriculture and ranching and an additional 100,000 km^2 degraded by heavy logging and intensive slash-and-burn farming, which results in an annual elimination of 2.5% of the entire biome. If this present rate continues, early in the 21st century there will be little forest left outside of small blocks in Zaire and the western Amazon (Myers 1988). The rates of deforestation, however, are accelerating in some areas, as indicated by the U.S. National Oceanic and Atmospheric Administration satellite reports of 204,000 km^2 of forest burned in 1987 in Brazil alone (Fearnside 1989b).

The agents of this destruction are farmers, ranchers, new settlers, and loggers. However, it is known that the root causes of the devastation are ill-conceived policies, get-rich-quick schemes, poor lending policies by multinational banks, and uncontrolled expansion of human activities associated with development projects (Morell 1990).

MAIN FACTORS RESPONSIBLE FOR DEFORESTATION

Logging

Logging has been an important factor in west-central Africa and particularily in southeast Asia. Much of the logging in Africa has been in combination with agricultural expansion. In southeast Asia, much of the forest is dominated by one family of trees (Dipterocarps), which makes timber harvesting much easier. Because these forests are a cheap resource and close to the Japanese market, there has been a wholesale devastation of the southeast Asian timber stocks. Many countries in the area have banned logging because they have no commercially valuable forests left. At the present rate, virtually all of southeast Asia's tropical forests will be gone by the end of the century. This wood feeds the insatiable appetite of the Japanese lumber companies for products such as paper, cardboard, veneers which are often used in exports, and plywood sheets which are used a couple of times in concrete building construction and then discarded.

In the Amazon, logging has had a rather insignificant influence. However, highway construction from the central Amazon should reach the Pacific Ocean at about the same time that Asian forests have been depleted, thus opening the Amazon to the Japanese market (Fearnside 1988).

Agriculture

Forest conversion for agricultural production has had a much greater influence in west-central Africa and southeast Asia than in the Amazon. This difference is due mainly to reduced access into the Amazon region and consequently its smaller population.

Cattle

The "hamburger connection" has been an important factor driving deforestation in Central America, where over 60% of the land in the last 30 years was converted to cattle ranches. Much of the beef production is exported to the fast food industry of North America. The United States imports over 300 million pounds (136 million kg) of beef from Central America annually, which is 90% of Central American beef exports. One hamburger represents 5.1 m^2 of tropical forest (Uhl and Parker 1986).

This "hamburger connection" is not a factor for South American cattle production because South

American beef cannot be imported into North America due to uncontrolled diseases in South American herds. The Amazon region is a net importer of beef. Why then are there 50,000 livestock operations in the Brazilian Amazon (Hecht 1989) with over 8 million cattle (Hildyard 1989a)?

The granting of land title to whomever deforests a piece of land is a centuries-old legal practice in the Brazilian Amazon (Fearnside 1989b). Simply, those who clear the forest have a stronger legal claim to a piece of land than those that do not; this is sufficient incentive for clearing a tract of forest (Hecht 1989). Having livestock is the easiest means of claiming land, obtaining tax breaks, cashing in on government subsidies, and making gains through land speculation (Fearnside 1988). The value of ranch land has appreciated above levels of inflation; therefore, there is a powerful motive to initiate cattle ranches. A whole industry has developed around clearing land for pasture, selling it quickly, making a profit, and then moving onto new forest areas (Hecht 1989). Twenty million hectares of the Amazon have passed from public to private lands in the last decade.

Why is cattle production such a major factor in deforestation and not crop production? If a sizable piece of land was desired, then a large area of crop would have to be planted, usually manually, requiring a large labor force. A crop must be harvested when ripe and sold immediately, regardless of price. This is not profitable for an individual farmer and cultivated land will only last 2 to 3 years without fertilizers while a pasture may last for 10 years. Beef, however, may be held and then sold when prices are high. Beef pays the highest price of any source of protein (Hecht 1989).

Development Projects

The activities of numerous development projects undertaken to harness and extract the resources of the tropics for financial and employment gains are having a tremendous influence on the rainforest. Following are just a few of the projects underway or about to commence in the near future. Many projects are funded by the World Bank, Inter-American Development Bank, and CIDA with tax dollars from North America. Europe and Japan have also become important sources of investment capital.

The Grande Carajas Project

This large project is located in northeast Brazil on 18 billion tonnes of high grade iron ore. This, the world's largest deposit, will last at least 250 years (Fearnside 1989b). There are plans to complete 20 pig iron mills, although only 11 have been granted incentives (Fearnside 1988). These mills are being fueled with charcoal from the surrounding forest. This project will eliminate 900,000 km^2 of forest, approximately one-sixth of the Brazilian Amazon, which is an area equivalent to Britain and France combined (Treece 1989).

2010 Plan

This is a plan set up by the Brazilian government for development until the year 2010. Under this scheme, 136 hydroelectric dams are planned which would flood a minimum of 26,000 km^2. Experts feel that, due to inadequate topographical surveying, there will be at least 10 times this area innundated. Half a million people, mainly Indians, squatters, goldminers, and poor peasants, will be forcibly removed from their land to make way for the dams (Hildyard 1989a). The Balbina Dam flooded 2360 km^2 of tropical forest; the vegetation was left to decompose and this resulted in the creation of acidic anoxic water which is corroding the power generating turbines (Fearnside 1989c). The Babaquara Dam alone will flood 7200 km^2, creating one of the world's largest man-made lakes (Hildyard 1989a).

The Calha Norte Project

This is a major program in Brazil to militarize, colonize, and develop the lands along Brazil's 6500 km frontier with Columbia, Venezuala, Guyana, Suriname, and French Guyana. This national fear of foreign invasion will directly affect 50,000 to 60,000 Indians and degrade the rainforest within the boundaries of the project which encompasses 24% of the legal Amazon territory (Trece 1989).

The Polonoroeste Project

This highway construction project from southern Brazil into the Amazon has precipitated a massive migration of 500,000 landless peasants. They have begun hacking down much of the forest in the states of Rondonia and Acre to convert the rainforest into failing agricultural land. This has been to the detriment of many Indian tribes and the rubber tappers, such as Chico Mendes, who was killed in 1988 as the dispute over land-use escalated.

Transmigration

In Indonesia, 3 to 4 million people have been moved from densely-populated islands to less-populated islands as part of a transmigration project to reduce population pressures, create agricultural jobs, and establish sovereignty in sparsely-populated areas. Millions of hectares of climax tropical rainforest have been destroyed in the process. An additional 65 million people are to be resettled over the next 20 years (Probe International).

Mining

A recent decree by President Sarney of Brazil has allowed gold miners to enter the Yanomami tribal lands in the state of Roraima. There are now over 100,000 gold miners combing the Indian lands.

IMPLICATIONS OF DEFORESTATION

Climate

Many plants and crops growing in the moist tropics are vulnerable to fluctuations in climate. The changing climate associated with deforestation is becoming evident from longterm climate data. The increasing fluctuations in the levels and timing of precipitation have had an impact on the production of some agricultural products. In an area of the Western Ghats of India, there has been a 13% decline in the number of rainy days and an 8% decrease in precipitation associated with the increased loss of the forests. Insufficient moisture has lead to the abandonment of tea plantations in the area (Myers 1988). In Peninsular Malaysia, a decline in precipitation along with decreased predictability has resulted in the abandonment of 20,000 ha of paddy ricefields and a marked decline in the production of an additional 72,000 ha (Myers 1988). Diminishing precipitation levels associated with deforestation have also been recorded in the Ivory Coast and the Philippines where coconut plantations are dying.

Panama has lost 70% of its forests in the last 30 years. Similar losses have occurred around the Panama Canal (Simons 1989). The canal works on a system of tiered locks in which the upper locks are recharged with water from the surrounding natural watershed. The removal of the neighboring forest has created prolonged dry seasons and already the canal has had to close periodically due to the lack of water.

The hydrological cycle of the Amazon provides a potentially disturbing relationship between development and precipitation. Moisture reaches the eastern Amazon with moisture-laden air brought in on the trade winds from the Atlantic Ocean. Subsequent evapotranspiration and easterly winds carry the moisture further inland. The mean recycling time of a water molecule from one rain episode to the next is 5.5 days (Myers 1988). About seven cycles are completed before the water reaches the Andes (Jose Lutzenberger, pers. comm.). Through the processes of evapotranspiration and water recycling, half of the precipitation falling in the Amazon comes from the forest itself (Molion 1989). Removal of the forest would cause significant reductions in precipitation levels. Of greater importance, however, would be the creation of a self-reinforcing cycle of increased drying and drought severity for the remaining forests (Myers 1988). Consequently, a replacement of the tropical moist forest with more drought tolerant forms of scrubby, open vegetation would ensue. This could have repercussions for the climate far beyond the boundaries of the Amazon, such as changes in temperature and precipitation levels in North America.

Presently a large portion of the rainforest in the eastern Amazon is being removed with development projects, such as the Grande Carajas iron ore project, and cattle pasture formation in the states of Para and Mato Grosso. Prolonged flooding and droughts are already being noticed in the Amazon region. Fires have been mainly limited to areas where the forests have been felled and the slash left to dry. This situation is changing with the occurrence of greater fluctuations in precipitation and longer periods of drought. In the unusually dry year of 1982/1983 on the island of Borneo, fire escaped from shifting cultivator's fields and burned 45,000 km^2 of tropical forest (Fearnside 1988).

Carbon Dioxide

The production of CO_2 globally is estimated at 5.2 gigatonnes (billion metric tonnes)/year. The burning of the tropical forests make up about 25% of this total (Myers 1988). Fifty gigatonnes of carbon would be released if the total Amazon was converted to cattle pastures (Fearnside 1988). Such a contribution of CO_2 through both the burning of the vegetation and by destroying the trees which fix carbon through photosynthesis would greatly enhance the greenhouse effect (Molion 1989).

Indigenous Societies

Many of the traditional ways of the indigenous societies have suffered from deforestation and exploitation at the hand of European immigrants. One of the greatest threats to the indigenous cultures is the encroachment of values from the "consumer society" (Hildyard 1989b). In the traditional Indian community, a person who accumulates things is evidently one who lacks social relations with others and has no one with whom to share (Bunyard 1989). The Brazilian Indian populations have declined from approximately 8 million to less than 200,000 today (Posey 1989).

Biological Diversity

The tropical rainforests house an astonishing array of species: 155,000 of the 250,000 known species of plants, 80% of all insect species, 90% of the world's non-human primates, and five to 20 times more tree species than temperate forests. Many birds which summer in Canada, such as vireos, warblers, thrushes, and flycatchers, overwinter in the tropical rainforests. Rainforest destruction will drive 750,000 species to extinction by the year 2000 (Probe International). Population studies of insects in the forest canopy have been extrapolated to make estimates that there may be as many as 30 million insect species in the world, many in the Amazon alone (Erwin 1983). The plant species of the tropics have been a significant supplier of medicinal and crop plants for the planet.

REASONS FOR OPTIMISM

Never has there been a time when one could feel more optimistic for the future of the tropical rainforests. This may seem ironic with the atrocious destruction presently laying waste to this biome, but there are a number of efforts which exemplify the positive activities underway.

Sustainable Forest Management

Incipient research has provided evidence that sustainable forest management is possible. Selective and sustainable clear-cut forestry projects have been successful in Suriname, Columbia, and Peru (Gradwohl and Greenberg 1988).

Japanese farmers at Tome Acu, Brazil have developed sustained-yield agroecosystems based on successional processes which mimic the natural stratified vegetation structure of rainforest vegetation (Uhl et al. 1989). This polyculture of cash crops is sustainable and the soil under these systems becomes richer in nutrients than that of the adjacent climax rainforest (Scott Subler, pers. comm.).

Parks and Reserves

Recent interest in the conservation of tropical rainforest habitat has stimulated the creation of many parks and reserves. Many of these areas are setting precedents for how forest preservation, with limited sustainable use, can benefit the surrounding community. Financial support from conservation organizations is playing an increasing role in rainforest preservation. Some notable examples of reserves established recently are the Sian Ka'an Bioshpere Reserve in Mexico (528,000 ha), Jaguar Reserve in Belize, La Amistad Bioshpere Reserve in Costa Rica (500,000 ha), Monteverde Cloud Forest Reserve in Costa Rica (30,000 ha), Corcovado National Park in Costa Rica, The Kuna Yala Biosphere in Panama, The Cuyabeno Wildlife Production Reserve in Ecuador (254,760 ha), Manu Biosphere Reserve in Peru (1.8 million ha), Beni Biosphere Reserve in Bolivia, Doi Inthanon National Park in Thailand (482,000 ha), Dumoga Bone National Park in Indonesia (300,000 ha), Endau-Rompin Forest in Malaysia (200,000, possibly 900,000, ha), Krau Wildlife Reserve in Malaysia (537,000 ha), Taman Negara National Park in Malaysia (4.3 million ha), and Korup National Park in Cameroon (126,000 ha).

In April 1988, President Barco of Columbia turned over 6 million ha of rainforest to the native peoples. Now 18 million ha of the Columbian Amazon belongs to 70,000 Indians. Parks and Indian lands now protect 22.5 million of the 38 million ha Columbia has in the Amazon region (Bunyard 1989). These forests may not be sold or converted to any non-forest use, even by the Indians. Bolivia is presently discussing with Columbia how they may preserve their forests in this manner.

Iguana Ranches

In Panama, a project has been established to raise captive-bred green iguanas in the forest and harvest them for meat. This project has been a resounding success and encourages Panamanians to conserve the forest for such an economic use. It is estimated that the forest used as iguana pasture produces 10 times more meat than would be possible by clearing and raising cattle (Cohn 1989). The project has now expanded into Costa Rica.

Extractive Reserves

The opportunity arose for protecting areas of Amazonian forest under sustainable use in 1985 when the Brazilian National Council of Rubber Tappers and the Rural Worker's Union proposed the creation of extractive reserves for the extraction of natural forest products such as rubber, fiber, seed oils, and nuts (Fearnside 1989a). Provisions for extractive reserves were included in Brazil's constitution on October 5, 1988. The first six reserves have been established in the state of Acre, with three more formed in the state of Amapa. A total of 20 extractive reserves are planned in Brazil, covering an area of 22,000 km^2.

In Peru, it was found that the collection of latex, fruit, and nuts would generate $7,000/ha. This is six times the amount that could be generated through logging or cattle (Morell 1990).

CONCLUSION

The problems facing the world's tropical forests seem insurmountable; however, recently it has become evident that positive actions can and are being taken to counteract the devastating trends. Most decisions regarding the future of the tropical rainforests will be made in the political arena; however, it is paramount that individuals express their concerns for the survival of intact rainforest ecosystems by supporting projects such as World Wildlife Fund's Guardian of the Amazon program. An individual can then not only preserve rainforest habitat but send a clear message to the Amazonian Pact of Nations that the conservation and sustainable use of the tropical rainforest is an economically viable alternative to conversion to some type of non-forest use.

It is important to remember that the fate of the tropical rainforests will be decided, if not by legislation and policy decisions which favor the conservation and sustainable use of forests, then by commercial loggers, cattle ranchers, slash-and-burn farmers, and other agents of forest destruction which have little longterm planning in their design. It does not really matter whether it takes 20 or 60 years before we come to the last tree in the rainforest. What is important is that future generations may inherit a world with tropical rainforests in perpetuity. A South American tribal legend truly provides forewarning, "The rainforest supports the sky; cut down the trees and disaster follows."

WHAT YOU CAN DO TO SAVE THE TROPICAL RAINFORESTS

(1) Communicate your views on saving tropical forests to your local and federal polical leaders; the Honourable Michael Wilson, Minister of Finance, is Canada's representative at the World Bank. Canadian tax payers contributed over half a billion dollars in 1986 to multilateral development banks.

(2) Support conservation organizations which are funding projects aimed at supporting the conservation and sustainable use of tropical rainforest habitat. One such organization, World Wildlife Fund Canada, has launched the Guardian of the Amazon program hoping to raise $3 million annually to support 266 projects. These projects will conserve and protect rainforest habitat throughout the Amazon region. Over the last 2 years, Canadians have supported the conservation of 60,000 acres (24,000 ha) of rainforest in Latin America. A $25 contribution to the program would protect an acre of rainforest. For more information contact: World Wildlife Fund, 60 St. Clair Avenue East, Suite 201, Toronto, Ontario M4T 1N5.

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7. SUMMATION

CONCLUDING REMARKS

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In the introduction, I briefly outlined what was was needed to complete a successful negotiation. As you discovered each working session was a fact a negotiation - some more active than others. Most working sessions include a lot of discussion time to promote dialogue and to work towards a consensus through positive negotiation. I hope that you have identified and questioned your assumptions and changed those that no longer fit with the facts that you heard during the past three days.

The solution to wildlife concerns on the prairies depends upon the approach of agriculture to land management. A farmer who ploughs marginal land knows of the loss of soil and lack of water percolation in the water table. A farmer who drains a slough feels the effects of a lower water table and may have a flooded field in a wet year. The downstream land owner knows of both because of the floods that occur from rapid runoff and the lower water table.

Wildlife also feel the effects of these land practises because of the loss of habitat. The decline of waterfowl populations and the large number of endangered and threatened species on the prairies are testament to our use of the land. There is no adversary here. The common root problems are those factors that conspire to encourage the farmer to plough marginal land and drain sloughs.

We have separate wounds. The solution is not bandages but an effective antibiotic.

Walter Moser eloquently talked of the spiritual and emotional development of children and how the environment can play a key role in unlocking this energy and protecting our environment. Joanne Joyce talks of a struggle with a municipal government to reroute a proposed road around a tall-grass prairie. A visit to the site brought the councillors to their knees as they told stories from their childhood about the flowers that they had not seen since.

In Edmonton, the nature center wanted to tell the story of the peregrine to children at Christmas. But conflict with Christmas and the Oilers - we had Wayne Gretsky back then, would limit attendance at this busy time of year. The solution was to offer dog sled rides and invite Santa at 2 pm. But at two o'clock it was announced that he would be 30 minutes late. As the parents fidgeted with their excited children, they were told that the puppet show was about to start and would end before Santa arrived. After a packed performance, Santa arrived in a military helicopter, precisely on time! As our negotiation with society continues we must market our message intelligently.

Stuart Houston quoted Farley Mowat who said that he does not worry about the facts, he writes the truth. While this statement could have several interpretations, it exemplifies the dilemma between society and science that Walter Moser discussed. Science deals in cold hard facts; society with its feelings and emotions that drive actions. They will grind together if they are moving forward. We need emotional translators to market science to society. In Dr Moser's model we should struggle for understanding not just knowledge.

Mike Kelly gave us one example of such a transition. The World Conservation Strategy (WCS) which received limited attention was written by hundreds of scientist and published in 1980. The Bruntland Commission's report "Our Common Future" which elaborates on the WCS and has received wide circulation, was written by politicians and social leaders. "Our Common Future" builds on the WCS but its basic accomplishment was to translate the WCS for the public and world leaders.

In the political process we need to reflect on how well we deliver our message. Should we limit our input to confrontation in the media when we consider a poor decision has been made? A more effective strategy is to work with politicians on issues before decisions are made. At election time interview candidates to ensure that they are aware of environmental issues. Participate in nomination meetings to nominate environmentally sympathetic candidates. Finally, meet with your elected politicians to identify problems and environmental solutions.

Often we are ineffective in confronting environmental problems. In this great negotiation, we have found the enemy and it is us. We must continue effective dialogue in our search for sustainable use of our prairies and this planet.

In the shorebird sessions speakers described the concrete actions now underway to save shorebird habitat in the prairies of the U.S. and the needs in Canada. There is a growing need to become aware of the impact of conservation activities to enhance habitat for other species on the habitat of shorebirds. In particular we need to learn more about the effects of water levels and drought on the seasonal habitat requirements of shorebirds. Guy Morrison described the international aspects of shorebird conservation. He, together with Tony Diamond, talked about songbirds in the tropics. We are reminded that many species of birds depend not only on a healthy environment in Canada but also in Central and South America where conservation resources are even scarcer than in Canada.

Two concrete accomplishments of the past three days are the contributions by the Saskatchewan Natural History Society from the workshop proceeds of $1000 each to the WWF's Guardians of the Rain Forest program and to the Canadian Nature Federation's new program to assist with the purchase of Grasslands National Park.

Attendance at the workshop was 400 people with 305 registrants. There is a saying "too many cooks spoil the broth" but I prefer "many hands make light work." There is nothing cooking here, for we are in a construction phase! On behalf of all of you I thank the host committee led by Dale Hjertaas, the Provincial Museum for providing space and logistical support, the speakers and sessions chairman for their insightful presentations, and all of the agencies who provided financial resources and travel support for speakers.

A ground squirrel eats for 3 or 4 months and sleeps for the rest of the year - summer smorgasbord. At lunch someone mentioned that their brain was stuffed. Can a three-day feast at this workshop last three years? The proceedings will provide a snack along the way.

The next workshop will be in Manitoba in early 1992. "Keep up the fight as though your life depends on it - because it does."

NATURAL HISTORY OCCASIONAL PAPER TITLES

No. 1 Alberta Birds 1961-1970. 1976. T.S. Sadler and M.T. Myres. 314 pp.

No. 2 Mammals of the Edmonton Area. 1979. Hugh C. Smith. 34 pp.

No. 3 A Bibliography of Alberta Ornithology. 1981. Martin K. McNicholl, Philip H.R. Stepney, Peter C. Boxall and David E. Spalding. 380 pp.

No. 4 Plants and the Blackfoot. 1982. Alex Johnston. 106 pp.

No. 5 Rare Vascular Plants of Alberta. 1984. John G. Packer and Cheryl E. Bradley. 112 pp.

No. 6 A Checklist of the Mammals of Alberta. 1985. Hugh C. Smith. 11 pp.

No. 7 Mammals of Southeastern Alberta. 1986. Hugh C. Smith. 59 pp.

No. 8 A Bibliography of Alberta Mammalogy. 1987. David M. Ealey. 400 pp.

No. 9 Proceedings of the Workshop on Endangered Species in the Prairie Provinces. 1987. Geoffrey L. Holroyd, W. Bruce McGillivray, Philip H.R. Stepney, David M. Ealey, Garry C. Trottier and Kevin E. Eberhart (eds.). 367 pp.

No. 10 Natural History of the Bistcho Lake Region, Northwest Alberta. 1988. W. Bruce McGillivray and Ross I. Hastings (eds.). 106 pp.

No. 11 A Checklist of the Mammals of Alberta (Revised 1989). 1989. Hugh C. Smith. 7 pp.

No. 12 Natural History of the Andrew Lake Region, Northeastern Alberta. 1990. W. Bruce McGillivray and Ross I. Hastings (eds.). 97 pp.

No. 13 Alberta Birds, 1971-1980. Volume 1. Non-Passerines. 1991. Harold W. Pinel, Wayne W. Smith and Cleve R. Wershler. 243 pp.

No. 14 Bibliography of the Family Catostomidae (Cypriniformes). 1991. John Clay Bruner. 224 pp.

No. 15 Proceedings of the Second Endangered Species and Prairie Conservation Workshop. 1991. Geoffrey L. Holroyd, Gordon Burns and Hugh C. Smith (eds.). 284 pp.